AUGUST, 1933.

GENERAL PHYSICS.

ADSORPTION.

3271. Adsorption of SO_2 and CO_2 in the Region of Small Equilibrium Pressures. A. Magnus and H. Giebenhain. *Zeits. f. phys. Chem.* 164. *Abt.A.* 3–4. *pp.* 209–222, *April,* 1933.—The adsorption of SO_2 at temperatures between 0° and 200° C. and of CO_2 at 0° C., has been measured on different types of charcoal at low pressures. The heat of adsorption as determined from the temperature coefficient of the amount adsorbed decreases progressively with increase in the amount adsorbed in agreement with the earlier calorimetric measurements [see Abstract 1012 (1931)]. The shape of the adsorption isotherm indicated the existence of active centres at the charcoal surface, and these could be poisoned to any required extent by treatment with oxygen. F. J. W.

3272. Influence of Combined Oxygen on the Adsorption of Vapours by Porous Solids. Part I. L. J. Burrage. *J. Phys. Chem.* 37. *pp.* 505–510, *April,* 1933.—Great care was taken to remove the last traces of oxygen from the charcoal. It was subjected to prolonged baking out at 800° C. and then flushed out with CCl_4 vapour at about 100° C. With this carefully prepared charcoal, the carbon tetrachloride adsorption isothermals at 25° C., when determined using a static technique, were a series of rectangular steps. Moreover, the equilibrium was attained instantaneously both during adsorption and desorption. The isothermal was completely reversible. F. J. W.

3273. Nature of the Sorption of Water by Charcoal. J. W. McBain, J. L. Porter and R. F. Sessions. *Am. Chem. Soc., J.* 55. *pp.* 2294–2304, *June,* 1933.—Upon the basis of measurements of the expansion of charcoal when exposed to water vapour and of the highly distinctive isotherms obtained with rigorously evacuated charcoal, it is concluded that neither the hypothesis of capillary condensation nor that of high compression is applicable, but that water is adsorbed or persorbed as a two-dimensional liquid film permeating the accessible structure of the charcoal. The results are in accordance with observations on density and on the specific heat of the sorbed water. Data for other liquids are adduced for comparison. AUTHORS.

3274. Studies on Adsorption. Part V. Sorption of Vapours by Activated Charcoal. Part VI. Comparison of Isothermals of CCl_4 and CS_2 on Charcoal. L. J. Burrage. *Faraday Soc., Trans.* 29. *pp.* 665–676, *June,* 1933.—The effect of C_xO_y on the sorption of water vapour by charcoal has been investigated, some 650 experimental points being obtained. The water isothermal, obtained after flushing out, has been compared with those obtained after evacuation at higher temperatures. The detailed form of the isothermal has been obtained between 23·76 mm. and 8 mm. and the pressure and quantity increments of the steps noted and discussed. A CCl_4 isothermal has been determined on the same sample of charcoal and a comparison made with one obtained by desorbing to constant pressure in an air stream. The detailed structure of the isothermal has been obtained below 4 mm. and a comparison has been made between the pressures at which the steps occur and those obtained with CCl_4 on another charcoal. Tests have been carried out on the relative capacity of charcoals for CCl_4 and CS_2 at high and low pressures. Certain anomalies in the relative order of the charcoals have been discussed and a hypothesis advanced as to the mechanism in these cases. An isothermal has been termined for CS_2, which gives rise to a reversible hysteresis loop. The CO_2 liberated from the C_xO_y on the surface has been noted. [For Parts I–IV see Abstract 2100 (1933).]

AUTHOR.

3275. Activated Adsorption. L. J. Burrage. *Faraday Soc., Trans.* 29. *pp.* 677–678, *June*, 1933.—A further criticism of the experimental evidence for an activated energy of adsorption has been advanced and a number of cases quoted which arise from recent investigations.

AUTHOR.

3276. Mechanism of the Activation of Carbon. N. Bach and I. Lewitin. *Kolloid Zeits.* 64. *pp.* 22–30, *July*, 1933.—The adsorptive power of natural and artificial (retort and electrode) graphites towards crystal violet and phenol have been measured before and after treatment with CO_2 at 1000° C. Natural graphites undergo loss, and artificial ones a slight rise, in adsorptive power as a result of roasting; the former show agglutination and increase in size of the particles, the mean thickness being increased two- to three-fold and the mean surface eight-fold. Microscopic examination shows that, as roasting continues, the particles assume an increasingly smooth surface and a simpler geometric form. Of importance in the activation of charcoal is, not the burning-off of the carbon crystals, but the combustion of organic admixtures and the liberation of the elementary crystals. T. H. P.

3277. Phase Boundary Potentials of Adsorbed Films on Metals. Part I. Oxygen on Gold. H. K. Whalley and E. K. Rideal. Part II. Iodine on Platinum. L. Jacobs and H. K. Whalley. Part III. Interaction of Copper and Iodine Vapour by the Method of Surface Potentials. H. K. Whalley and E. K. Rideal. *Roy. Soc., Proc.* 140. *pp.* 484–504, *June* 1, 1933.—An attempt has been made to evaluate the difference in contact potential between gold and oxidised gold. It was found impossible to prepare a gold surface entirely free from oxygen contamination. The minimum value of the p.d. between clean and oxidised gold is 1·56 volts, a value comparable with those obtained from measurements of the thermionic work function. When a platinum plate is flooded with a solution of iodine in petrol ether the air-metal p.d. increases and then decreases as the iodine evaporates. This decrease follows a simple exponential law until 95 % of the iodine has evaporated. The evaporation constant, K, depends on the temperature, and the air-metal p.d. Z of the platinum before treatment with iodine. The relation between K and Z is given by the equation $K = Be^{aZ}$ where a and B are constants which are dependent on the temperature. Further, for a given value of Z, log K is a linear function of $1/T$: $\log_{10}K = \log_{10}A - \dfrac{\lambda}{2 \cdot 303\,RT}$ where A is a constant and λ the gram molecular heat of desorption of iodine. Both λ and A are functions of Z. Collecting the results it is shown that they satisfy the equation

$$K = Ae^{-\frac{34,990 - 46 \cdot 17\,Z}{RT}}$$

The changes in Z are attributed to varying amounts of oxygen adsorbed and chemi-adsorbed on the platinum. They may be represented by $Z = A_0 + A_1 \theta$ where θ is the fraction of surface covered with oxygen and A_0 and A_1 are constants. F. J. W.

3278. Electrical Adsorption and Stability of Colloids. A. Ganguli. *Kolloid Zeits.* 64. *pp.* 65–72, *July,* 1933.—The method previously adopted in the case of chemical adsorption [see Abstract 268 (1932)] is used to obtain an expression for ion adsorption. The original charge of a colloidal particle depends mainly on the chemical adsorption, which is determined by the specific nature of the adsorbing surface, the adsorption potential, and the mobility and valency of the ions. Diminution of the charge and stability of the colloidal particles is attributed to previous adsorption of the coagulating ion. If the chemical adsorbability of the latter is greater than that of the ion with the same charge, reversal of the charge occurs. Increase in the charge at low concentration of the coagulating electrolyte is due to greater readiness of absorption of the ion of similar charge. Fall of the colloid charge on dilution is ascribed to disturbance of the adsorption equilibrium of the peptising ion. The causes of anomalous behaviour of the dilute sol towards electrolytes are : stronger adsorption of the similarly charged ion at low concentration, with consequent rise in the charge and stability ; sensitisation, owing to initial fall of the charge on dilution ; increase in the separation of the colloidal particles, and diminution in the active surface. The influences of non-electrolytes are : by their adsorption, they depress adsorption of the ions and thereby effect lowering of the charge and stabilisation ; increased adsorption of the coagulating ion owing to decreased dielectric constant. T. H. P.

3279. Theoretical Explanation of the Freundlich Adsorption Isotherm. B. Tamamushi. *Chem. Soc. Japan, Bull.* 8. *pp.* 120–125, *April,* 1933. *In German.*—A derivation of the Freundlich adsorption isotherm starting from the Gibbs adsorption equation. F. J. W.

ATOMIC AND MOLECULAR STRUCTURE.

3280. Interpretation of Aston's Data. W. Swietoslawski. *Comptes Rendus,* 196. *pp.* 1600–1602, *May* 22, 1933.—From the differences in the number of neutrons in, and the masses of, the nuclei of various pairs of isotopes the average mass of a neutron is deduced as 0·9997, and that of a demihelion, D_h as $(A_n - 0\cdot9997x)/n$, where A_n is the mass of the atomic nucleus of element of atomic number n, and x the number of neutrons therein. Thus determined D_h diminishes from 2·00053 for helium to 1·9974 for krypton, and then rises to 1·9998 for lead, and (by extrapolation) to 2·00032 for uranium. Deducing from this result the mass of the atomic nucleus of uranium the loss of mass consequent on the radioactive transformation of uranium into lead is 0·033, which agrees fairly with that (0·041) deduced from the heat emitted. C. A. S.

3281. Isotopic Constitution and Atomic Weight of Lead from Different Sources. F. W. Aston. *Roy. Soc., Proc.* 140. *pp.* 534–543, *June* 1, 1933.—Ordinary lead and a variety of radiogenic leads have been analysed with the mass-spectrograph by means of their volatile methyls and the abundance of their isotopes estimated by means of photometry. The presence of a small quantity of hydride has been detected. This has been measured and corrected for. Measurements of the packing fractions have been made, but with somewhat inconclusive results. The atomic weights are found to agree fairly well with those found chemically, but the abnormally low value reported for lead from Great Bear Lake is not supported. [For previous work see Abstract 2283 (1932).] AUTHOR.

3282. Concentration of H^2 Isotope. G. N. Lewis and R. T. Macdonald. *J. Chem. Phys.* 1. *pp.* 341–344, *June*, 1933.—A method is described of producing any desired concentration of the isotope of hydrogen H^2 by electrolysis. Starting with 20 l. of water from an old commercial electrolytic cell and electrolysing in four stages until only 0·5 c.c. of water remained, this water had the specific gravity 1·073. Having shown that no large accumulation of the heavy isotopes of oxygen occurs and assuming that the density varies linearly with the fraction of H^2, 2/3 of the hydrogen in this water is H^2. It is shown that a further reduction of volume to one-quarter will give 99 % H^2. In our electrolyses the percentage loss of H^1 is to the percentage loss of H^2 in the ratio of five to one. By two methods we have found 1 in 6500, as a provisional value for the concentration of H^2 in ordinary water. AUTHORS.

3283. Theoretical Considerations Concerning the Separation of Isotopes. H. Eyring and A. Sherman. *J. Chem. Phys.* 1. *pp.* 345–349, *June*, 1933.—The relative importance of effusion processes, the half quanta due to van der Waals forces, and half quanta associated with homopolar bonds is considered with respect to the question of the separation of isotopes. Specific reaction rate constants for various isotopic molecules in effusion processes have been calculated. It is shown that only in the neighbourhood of liquid hydrogen temperatures or lower are the half quanta due to van der Waals forces important. Specific reaction rate constants involving the zero point energy of homopolar molecules have been calculated for various isotopic molecules, principally those in which a hydrogen atom is one constituent, at temperatures of 20°K, 90°K, and 273°K. The advantage of working at as low a temperature as possible is rendered apparent. Even at ordinary temperatures the differences in the constants are in general much greater than in the case of effusion or van der Waals processes. A general equation is derived relating the concentration of the light and heavy isotopes, valid for any one of the three processes considered. AUTHORS.

3284. Spectroscopic Search for H^3 in Concentrated H^2. G. N. Lewis and F. H. Spedding. *Phys. Rev.* 43. *pp.* 964–966, *June* 15, 1933. —With hydrogen of which about two-thirds consists of the heavy isotope, H^2, a search has been made for the isotope H^3. This appears not to be present in ordinary hydrogen to the extent of 1 part in 6,000,000. Photographs are reproduced showing the relative fine structure resolution of H^1 and H^2. AUTHORS.

3285. Determination of the Angles between Covalencies from Measurements of Electric Dipole Moment. G. C. Hampson and L. E. Sutton. *Roy. Soc., Proc.* 140. *pp.* 562–579, *June* 1, 1933.—The principles of the methods of determining angles between covalencies from measurements of electric dipole moment have been explained, and the various methods have been classified. Some extensions of these methods to more complicated molecules have been described and one has been applied, using existing data from the di-phenyl sulphoxides. The causes and importance of possible errors have been discussed, and a method of minimising their effect has been described. A brief survey has been given of the applications of these methods which have been made up to the present. AUTHORS.

3286. Molecular Vibrations of Three-Particle Systems with Special Applications to the Ethyl Halides and Ethyl Alcohol. P. C. Cross and J. H. van Vleck. *J. Chem. Phys.* 1. *pp.* 350–356, *June,* 1933.—The vibrational potential of polyatomic molecules is discussed in the light of the theory of directed valence. Andrews' assumptions of " valence forces " are seen to be rather special, but at the same time are fairly good approximations under certain conditions. The normal vibrations of three-body systems are calculated for the potential function $V=\frac{1}{2}[k_1(\Delta r_1)^2+k_2(\Delta r_2)^2+k_3(r_1^{02}+r_2^{02})(\Delta\gamma)^2]$ with r_1, r_2 radial coordinates and γ an angular one. The potential terms proportional to $\Delta r_1 \Delta r_2$, etc., are treated as perturbations. These calculations are applied to the ethyl halide and ethyl alcohol molecules by considering the CH_3, CH_2 and OH groups as dynamic units. Force constants were determined which gave approximately the experimental frequencies. The calculation of the normal modes of vibration illustrate the approximate validity of the designation of the modes of vibration of unsymmetrical three-body systems as two independent radial motions and an angular motion. AUTHORS.

3287. Calculation of the Vibration Frequencies and Other Constants of the H_2O Molecule. J. H. van Vleck and P. C. Cross. *J. Chem. Phys.* 1. *pp.* 357–361, *June,* 1933.—The calculation is based on the Slater-Pauling theory of directed valence, but supplemented by data from the band spectrum of the diatomic OH molecule. The heat of dissociation and valence angle, obtained incidentally, are in good agreement with experiment. The " cross-terms " in the vibrational potential prove to be of subordinate importance. It is found that two of the fundamentals should fall near $2\cdot8\mu$, and that they should almost coincide. This designation of the observed wide absorption band at $2\cdot6$–$2\cdot8\mu$ as the superposition of two fundamentals agrees with Mecke's interpretation of the H_2O spectrum, but contradicts Johnston and Walker's. The computed value 1660 cm.$^{-1}$ of the third fundamental frequency ω_3 differs from experimental determinations by only 4 %, but any closer agreement than 15 % is accidental in view of the approximate nature of the theory. Since ω_3 represents a primarily angular vibration, its calculation is a particular test of the concepts of directed valence. AUTHORS.

3288. Nature of the Chemical Bond. Part V. Quantum-Mechanical Calculation of the Resonance Energy of Benzene and Naphthalene and the Hydrocarbon Free Radicals. L. Pauling and G. W. Wheland. *J. Chem. Phys.* 1. *pp.* 362–374, *June,* 1933.—The secular equations corresponding to the five canonical structures for benzene and the forty-two for naphthalene, considered as six and ten-electron systems, respectively, are set up and solved with certain simplifying assumptions, leading to energy values differing by $1\cdot1055\alpha$ and $2\cdot0153\alpha$, respectively, from those corresponding to unexcited (Kekulé-type) structures, α being a single exchange integral involving neighbouring carbon atoms. Equating these values to the empirical values of the resonance energy, α is found to be about $-1\cdot5$ v.e. It is pointed out that the dissociation of certain substituted ethanes into free radicals is due not to weakness of the carbon-carbon bond in the ethane but to the stabilisation of the free radicals resulting from resonance among the structures in which the unpaired electron is located on the methyl carbon and those in which it is on other atoms (ortho, para, etc., to the methyl carbon). The secular equations for a number of such radicals have been solved, neglecting excited structures. The experimentally determined heat of formation of hexaphenylethane from triphenylmethyl, 0·5 v.e., when equated to the calculated value $C-C+2\cdot2156\alpha$, with $C-C=3\cdot65$ v.e., leads to $\alpha=-1\cdot4$ v.e. The calculated tendencies towards dissociation are in satisfactory agreement with observation, such features as the smaller dissociating power of β-naphthyl than of α-naphthyl and of biphenylene than of diphenyl being accounted for, so that resonance among the structures considered may be accepted as the principal effect causing the stability of the hydrocarbon free radicals. [For Part IV see Abstract 5336 (1932).] AUTHORS.

3289. Electronic Structures of Polyatomic Molecules and Valence. Part V. Molecules RX_n. R. S. Mulliken. *J. Chem. Phys.* 1. *pp.* 492–503, *July,* 1933.—The approximate construction, for shared electrons in molecules RX_n, of molecular orbitals (" orbital " means one-electron orbital wave function) as linear combinations of atomic orbitals is discussed and illustrated by equations for RX_2, RX_3, RX_4 types. Properties of bonding, nonbonding, antibonding, also excited, molecular orbitals are described. Valence orbitals include both bonding and nonbonding types. RH_3 and H_3 orbitals are given as examples. Molecular orbitals constructed from atomic orbitals contain undetermined coefficients and implicit parameters (effective *Z*'s of the atomic orbitals) which make them very flexible. They are useful for a qualitative theory which can be compared with empirical, especially chemical and spectroscopic, data. They also have value in semi-quantitative calculations (van Vleck). Electronic structures, ionisation potentials, form and stability (at least some of these properties in each case) of the molecules CH_4, NH_3, H_2O, NH_4, CH_3, NH_2, BeH_2, RX_n are described and interpreted in terms of molecular orbitals. Empirical evidence is cited showing that the geometrical possibilities of forms RX_4 tend to produce stabler electron configurations than are permitted by the possible geometry of RX_3. The ultra-violet absorption spectra of CH_4, NH_3, and H_2O are discussed in relation to the ionisation potentials of these molecules. [For Part IV see Abstract 1670 (1933).] AUTHOR.

3290. Revision of the Atomic Weight of Indium. G. P. Baxter and C. M. Alter. *Am. Chem. Soc., J.* 55. *pp.* 1943–1946, *May,* 1933.—Purifications and high precision determination of the ratios $InCl_3 : 3Ag$ and $InBr_3 : 3Ag$ are described. The mean atomic weight was found to be 114·76. N. M. B.

3291. Revision of the Atomic Weight of Arsenic. Comparison of Arsenic Trichloride with Iodine Pentoxide. G. P. Baxter and W. E. Shaefer. *Am. Chem. Soc., J.* 55. *pp.* 1957–1963, *May,* 1933.—Arsenic trioxide was found to be unsuitable for high precision work owing to minute variations in composition and reducing power. Purifications and high precision determination of the ratio $6AsCl_3 : I_2O_5$ by the oxidation of a solution of the trichloride in sodium hydroxide by means of iodic acid are described. The mean atomic weight was found to be 74·916. N. M. B.

3292. Atomic Radius of Carbon in Diamond. V. Posejpal. *Comptes Rendus,* 196. *pp.* 1655–1657, *May* 29, 1933.—In continuation of a former paper [see Abstract 1671 (1933)] the author calculates atomic radii based upon the assumption that a photon can penetrate an atom only to the distance from the nucleus at which an electron would have an energy equal to that of the photon. Some small corrections to his earlier formula are adduced and his results now show good agreement with the experimental results of other authors. J. E. R. C.

See also Abstracts 3299, 3390, 3554, 3562, 3567, 3582, 3583, 3588, 3692, 3712, 3786, 3825.

COLLOIDS.

3293. Preparation of Colloidal Solutions of Alkali Metals. M. I. Gen, I. L. Zelmanoff and A. I. Schalnikoff. *Kolloid Zeits.* 63. *pp.* 263–268, *June*, 1933.—The possibility of preparing organo-sols of the alkali metals by condensing the supersaturated vapour of the metal in the vapour of the solvent and subsequently condensing the aero-sol thus formed, has been explored, but without satisfactory results. Such organo-sols may be obtained by passing the vapour of the metal directly into the solvent, the metal being vaporised in the body of the solvent by means of Foutreau's current. Sols thus prepared have concentrations up to 0·3 per cent and are highly stable, probably owing to the protection afforded by the alkali hydroxide arising from the interaction of the alkali metal with traces of water present. T. H. P.

3294. Migration Studies with Colloids. F. Hazel and D. M. McQueen. *J. Phys. Chem.* 37. *pp.* 553–582, *May*, 1933.—The effect of added ions upon cataphoretic velocity was observed in sols of positive and negative charge. A mixture of sols of opposite charge was found to be homogeneous in that the particles all had the same velocity and direction, though the stability was less than that of the original sols. Differences in the behaviour of sols are shown to be due to differences in the original sols as well as to the ions added. The mechanism of the mutual coagulation of positive and negative sols plus electrolyte is deduced to be a lowering of the stability of the system. A. S. C. L.

3295. Effect of Optical Constants upon the Mie Absorption Curves of Coloured Colloidal Systems. Part I. System Silver-in-Water. A. Krebs. *Phys. Zeits.* 34. *pp.* 490–492, *June* 15, 1933.—Values of the absorption coefficient of colloidal silver particles in water are calculated in accordance with Mie's formula for values of λ between 400 and 650$\mu\mu$. The results differ somewhat from those given by Gans [see Abstract 1199 (1915)] and by Feick [see Abstract 268 (1926)]. J. S. G. T.

See also Abstracts 3278, 3309, 3385, 3388, 3389, 3505, 3716.

CRYSTAL STRUCTURE AND PROPERTIES.

3296. Crystal Optics and Wave Mechanics. G. Wentzel. *Helv. Phys. Acta*, 6. 2. *pp.* 89–109, 1933.—An investigation is made of the types of crystal models based on wave-mechanics that lead most readily to the formulæ obtained in the theory of Ewald and Born for the propagation of light in crystals. The best crystals for this purpose are those which have a pronounced ionic lattice and, so far as X-ray pictures give us information, they have the electron clouds of the individual ions concentrated about certain centres of gravity of the charge and are separated from each other by almost empty spaces. If this picture of the charge distribution is idealised by supposing that the charge-clouds of the various ions do not overlap at all, but that every electron may be permanently allocated to one and the same ion we obtain the model of the "ideal insulator," which is used as a basis for the wave-mechanical investigation. It is found that the plane waves that may form in this model are exactly the same as in the Ewald-Born model; every ion is in this respect equivalent to a series of linear harmonic substitute oscillators whose directions of vibration, proper frequencies and amplitudes may be determined wave-mechanically. Detailed calculations are given. H. L. B.

3297. Structure of Real Crystals. F. Zwicky. *Helv. Phys. Acta*, 6. 3. *pp.* 210–217, 1933. *In German.*—A definition is given of secondary structure of crystals, which embraces all systematic thermodynamically stable deviations from the crystallographically ideal lattice. The author discusses to what extent this postulate is justifiable theoretically, and what conclusions of a simple character follow from it. Various effects are adduced to account for systematic imperfections in real crystals. A criticism by E. Orowan [see Abstract 859 (1933)] is shown to be groundless. H. L. B.

3298. X-Ray Examination of Electrolytic Chromium Deposits. G. R. Levi and M. Tabet. *Accad. Lincei, Atti*, 17. *pp.* 647–653, *April* 23, 1933.—Scherrer's method is applied to the determination of the dimensions of the particles in deposits of chromium obtained either by thermal reduction of potassium chromium chloride by powered magnesium, or electrolytically from solutions of chromic sulphate, chromic anhydride and sulphuric acid, or blue ammonium chromi-oxalate. Use is made of v. Laue's formula, various assumptions as to the uniformity in size of the chromium crystals, the similarity in lattice of the particles and their freedom from deformation, etc., being made. The lines of the photograms taken exhibit marked differences in the maxima of intensity and in width for the different preparations. A table showing the dimensions of the particles is given. T. H. P.

3299. Concentration of Valency Electrons in Binary Intermetallic Alloys. H. Perlitz. *J. Chem. Phys.* 1. *pp.* 335–336, *May*, 1933.—An extension of the work of Hume-Rothery. If the number of valency electrons of the first component of the binary alloy is m, and of the second is n; and if, in the phases with β-, γ-, and ϵ- structures the number of atoms of the first component is x and of the second y, then the concentration of the valency electrons k, is defined by $(mx+ny)/(x+y)=k$. This gives $x/y=(k-n)/(m-k)$. Since x/y is positive, m, n and k should satisfy the inequality $m \lesseqgtr k \lesseqgtr n$. It is concluded that the β-, γ- and ϵ-structures are not to be expected in binary alloys if both components have equal numbers of valency electrons. A β-, γ-, or ϵ-structure is to be expected if m is less and n greater than 3/2, 21/13 or 7/4. F. J. W.

3300. Structure of the Crystalline Platinocyanides. H. Brasseur. *Comptes Rendus*, 196. *pp.* 2015–2017, *June* 26, 1933.—A comparison of the optical properties (refringence, birefringence, and dispersion) of the platino-cyanides and of a compound recently studied by Sutton [see Abstract 2712 (1933)] has led the author to conclude that the groups CN are perpendicular to the planes of the groups Pt(CN), and that the refractivity of the group CN is greatest when the electric vector of the incident wave is parallel to the linkage CN. H. H. Ho.

3301. Crystal Structure of Borides of Type MeB_6. F. Laves. *Zeits. f. phys. Chem.* 22. *Abt.B.* 1–2. *pp.* 114–116, *June*, 1933.—These are conceived as three-dimensional networks of boron atoms, the gaps being filled in by the appropriate metal. This accounts, in general, for the isomorphism observed: further it is suggested that the forces involved are akin to those in inter-metallic substances. F. I. G. R.

3302. Composition and Structure of Artificial Spherulites. H. W. Morse, J. D. H. Donnay and E. Ott. *Am. J. Sci.* 25. *pp.* 494–498, *June,* 1933.—When artificial spherulites of barium-, strontium-, and lead-carbonates are prepared by diffusion and metathesis in gelatin two optically different forms are often obtained. They correspond to different chemical compounds, one of which is due to impurity (sulphate) in the gelatin. From the X-ray diffraction standpoint, the perfectly symmetrical spherulites behave like powders with random orientation. The deviations observed in the values of the refractive indices of a spherulite fibre (different from those of a crystal with the same composition and of the same modification) can only be accounted for on the ground that each fibre is an aggregate in itself, made up of variously oriented unit crystals. The usual order of magnitude of the unit crystals in these artificial spherulites is approximately 10^{-3} to 10^{-5} cm. [See Abstract 3695 (1932).] AUTHORS.

3303. Source of Error in Determination of Symmetry from Optical Extinction-Angles. M. H. Hey. *Min. Mag.* 23. *pp.* 367–370, *June,* 1933.—Mesolite is usually taken to be anorthic, but no trace of inclined extinction in the prism zone could be detected. Small prisms gave straight extinction, but when aggregate and parallel growths which were not lying quite flat were investigated, extinction angles up to 12° appeared. Another observation concerned sections alleged to be in the prism zone, but actually about $2\frac{1}{2}°$ in error. Optical work in convergent light settled the symmetry in this case. Diagrams show how these mistakes can arise. F. I. G. R.

3304. Optical Determination of Orientation of a Single Crystal. E. Jakowlewa. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 429–438, 1933. *In German.*—A method is described for determining rapidly the orientation of a given crystal face to the axis of a single crystal specimen. The error is between $\frac{1}{2}°$ and 1°. The method, which is applicable to any type of crystal, is an improvement and extension of the original method of Bridgeman, which depended upon measuring the intensity of a beam reflected at the surface of the specimen after etching. F. J. W.

3305. Quartz as a Standard for Accurate Lattice-Spacing Measurements. A. J. Bradley and A. H. Jay. *Phys. Soc., Proc.* 45. *pp.* 507–522, *July,* 1933.—A test has been made of the use of quartz as a standardising substance for very accurate lattice-spacing determinations. With CuK_α radiation it gives a very good photograph with many sharp K_α doublets, which may be measured with accuracy. A redetermination of the axial ratio from an X-ray powder photograph gave $c/a = 1\cdot10002 \pm 0\cdot00004$, and this value was confirmed by X-ray measurements on several other crystals. Assuming Bergqvist's value for d_{100} (4246·02 X units) it was found that $a = 4902\cdot9$ X, $c = 5393\cdot3$ X. Various specimens of quartz from different sources were compared by taking powder photographs in the same camera, one of the clear, colourless specimens being used to calibrate the camera, on the basis of the above values. The values of d_{100} at 18° C. all lay between $4245\cdot9_5$ and 4246·30. The clear colourless crystals gave $4246\cdot0 \pm 0\cdot05$. AUTHORS.

See also Abstracts 3292, 3314, 3316, 3317, 3606, 3644, 3661, 3674, 3810, 3811, 3812, 3813, 3814, 3823, 3824, 3825, 3826, 3827, 3842.

DIFFUSION AND OSMOSIS.

3306. Diffusion of Helium Through Quartz : Relation to Temperature. E. F. Burton, E. O. Braaten and J. O. Wilhelm. *Canad. J. of Research*, 8. *pp.* 463–467, *May*, 1933.—A qualitative study of the diffusion of certain gases through quartz has been made for ordinary temperatures and pressures. A nearly linear relation was found to exist between diffusion and pressure for constant temperature and a form of the equation satisfying the experimental results suggested. Temperature-diffusion curves were obtained and a comparison made to previous work. Permeability to helium of single quartz crystalline plates is independent of the direction in which the plate has been cut, but is only about one-half the value of that of fused quartz bulbs or plates. AUTHORS.

3307. Self-Diffusion of Hydrogen. P. Harteck and H. W. Schmidt. *Zeits. f. phys. Chem.* 21. *Abt.B.* 5–6. *pp.* 447–458, *June*, 1933. —The interdiffusion of para- into normal-hydrogen affords a means of measuring the coefficient of self-diffusion of hydrogen, since the kinetic properties of the two modifications are, as far as can be determined, the same. Measurements are made by two methods. In the first, two vessels, one of which contains normal H_2, the other a mixture rich in para-H_2, are connected for a measured period by an accurately bored tube. In the second, the back-diffusion of one modification against a stream of the other is determined. These determinations give, for the coefficient of self-diffusion, 1·28, 0·172, and 0·00816, at absolute temperatures 273°, 85°, and 20·4° Abs. respectively. J. P. A

3308. Diffusion of Hydrogen Through Platinum and Nickel and Through Double Layers of These Metals. W. R. Ham. *J. Chem. Phys.* 1. *pp.* 476–481, *July*, 1933.—Flow of hydrogen through single sheets of Ni and Pt with atmospheric pressure on ingoing side and pressure of 0·1/mm. on outgoing side follows the empirical equation

$$R = A\cdot((p_0^{\frac{1}{2}} - p_t^{\frac{1}{2}})/x)\cdot T^{-\frac{1}{2}}\cdot\epsilon^{-b_1/T}$$

similar to that given by Borelius, where p_t is small compared with p_0 but apparently proportional to p_0; with double layers of these two metals the b_1 of the exponential is dependent only on the metal at the outgoing surface, and is the difference between the work of escape from the outgoing surface and the heat of solution of hydrogen in that metal. The kinetic theory flow equation is sufficient to explain the p_t, and the variation of p_t with temperature may be used to compute the work function at the outgoing surface, and also to obtain values of m/k where m is the mass of the hydrogen atom and k the Boltzmann constant. AUTHOR.

3309. Determination of Pore Distribution According to Dimensions in Filters and Ultra-Filters. F. Erbe. *Kolloid Zeits.* 63. *pp.* 277–285, *June*, 1933.—A flow-pressure curve is determined experimentally for two suitable liquids from which are derived curves connecting pore number–pore width, cross-section–pore width, and flow–pore width of the filter or ultra-filter under investigation. From a knowledge of pore length, factors may be calculated by means of which absolute pore numbers may be found from the first two curves and viscosity from the last curve. An approximately true picture of the filter structure may thus be obtained. H. H. Ho.

See also Abstract 3666.

ELASTICITY AND PLASTICITY.

3310. Surface Strength of Glass and Other Materials. F. W. Preston. *Soc. Glass. Technol., J.* 17. *pp.* 5–8, *March,* 1933.—A discrepancy exists regarding the strength of glass according to whether the conditions of the test do or do not allow the surface of the glass to act as the starting point of a fracture. The strength of glass should be of the order of 1,000,000 lbs./sq.in., but the average window-pane will not withstand 10,000 lbs./sq.in. The author discusses a theory he has put forward that the factor governing the failure is more nearly connected with some physical quantity having the dimensions of surface tension (force per unit length) than with stress (force per unit area). Data obtained from experiments on glass fibres are shown to support this view and further evidence in support is also provided by experiments on the fracture of glass under steel balls and on the thermal endurance of glass. W. D. W.

3311. Theorem of Three Moments in General Form. F. Y. Tsai. *Tsing Hua Univ., Sci. Reports,* 2. *pp.* 19–36, *April,* 1933. *In English.*—The elastic behaviour of a beam may be defined by beam factors and loading factors, depending on the form of the beam and the manner of loading respectively. By separating these two in the analysis, the theorem of three moments is written in its most general form ; and applications to any type of beam with any loading can be made. The methods to be employed in such applications are fully discussed with examples. J. P. A.

3312. Reciprocal Relation for Linear Systems. A. Bloch. *Zeits. f. techn. Physik,* 14. 6. *pp.* 234–239, 1933.—A beam, supported horizontally at two ends, is subjected to two loads P_1 and P_2 at points 1 and 2 respectively. The depressions at these points may be expressed as $y_1 = P_1a_{11} + P_2a_{12}$, $y_2 = P_1a_{21} + P_2a_{22}$, when a new support is introduced at 2, let the deflection at 1 be $(y)_1 = P(a_{11})$; and similarly for a support placed at point 1, and deflection observed at 2. It is shown that $\frac{(a_{11})}{a_{11}} = \frac{(a_{22})}{a_{22}}$. This principle applies to any " linear " system, and examples of its application to other branches of mechanics and to electricity are given. J. P. A.

3313. Compressibilities of Gases at Low Pressures and Various Temperatures. W. Cawood and H. S. Patterson. *Chem. Soc., J. pp.* 619–624, *June,* 1933.—By the method previously used [see Abstract 4791 (1932)], C_2H_4, CO_2, N_2O, SO_2 and $(CH_3)_2O$ have been investigated at pressures between 1 and 3 m. of mercury and at various temperatures, including 0° C. Except for $(CH_3)_2O$, pv is related stricted linearly to p, so that $pv = p_0v_0(1 - Ap)$ or $pv = 1 - Ap$. From the slope of the lines, by the method of least squares, the compressibility coefficient $A = -d(pv)/dp$ is calculated. As the lines may be assumed to remain straight to zero pressure, such compressibility coefficients will be the limiting values. Compressibilities at high pressures are sometimes expressed by $pv = a + bp + cp^2 + \ldots$, where p^2, etc., take account of the curvature of the isothermals. In the present case $a = p_0v_0$ when $p = 0$, so that $A = -b$. Normal densities are converted to their limiting value by the factor $p_1v_1/p_0v_0 = 1 - A$, p_1v_1 referring to atmospheric pressure. Older density determinations indicating marked curvature of the $pv - p$ isothermals between 0 and 1 atmosphere are regarded as erroneous, but for such cases a new factor $p_0v_0/p_1v_1 = 1 + \lambda$ has been used for the ratio between normal and limiting densities. This factor $1 + \lambda$ is a mere ratio, λ alone having no physical significance. Although A and λ are usually small, their confusion, which is not infrequent, may result in considerable error, as, for instance, with $(CH_3)_2O$ and SO_2. From the results obtained the value 12·01 for the atomic weight of carbon is deduced. T. H. P.

3314. Brittleness, Plasticity and the Gliding Elements of α-Iron. F. Sauerwald and H. G. Sossinka. *Zeits. f. Physik*, 82. 9–10. *pp.* 634–643, *May* 23, 1933.—The ranges of brittleness and plasticity were investigated at low temperatures. Gliding (twin formation) was observed on the {112} plane at low temperatures. The {123} plane was established as translation surface at room-temperature. J. J. S.

3315. Elastic Constants of Aluminium Crystals. E. Goens. *Ann. d. Physik*, 17. 3. *pp.* 233–242, *June*, 1933. *From the Reichsanstalt.*—By dynamical measurements upon a number of aluminium monocrystals of different crystallographic orientations, the elastic constants s_{ik} are determined. In comparison with other metals of the cubic system, the elastic anisotropy is relatively small. The values of the moduli c_{ik} show that Cauchy's relation is not even approximately fulfilled. J. P. A.

3316. Elastic Constants of Rochelle Salt by a Dynamical Method. R. M. Davies. *Phil. Mag.* 16. *pp.* 97–124, *July*, 1933.—The theory of the method employed is given, and various theoretical problems concerning Rochelle salt piezoelectric resonators are described and discussed. The problems discussed include those relating to the orientation of the resonators with respect to the crystal axes and the correction of the simple frequency formula for finite lateral dimensions, secondary electrical effects, and adiabatic conditions. The correction for finite lateral dimensions is considered in detail, and the result applicable to the general case of a rectangular parallelepiped of crystalline material is given. The experimental method employed is then described, and the results for 15° C. compared with those calculated from statical experiments on the elastic moduli. The results for the temperature-variation of resonant wave-length show that for two types of resonator this quantity is a linear function of temperature between 0° C. and 20° C. A pronounced discontinuity occurs in the neighbourhood of 23° C., and, in the one case investigated at low temperatures, another discontinuity is found between − 14° C. and − 15° C. Other physical properties of Rochelle salt are known to exhibit similar discontinuities at these temperatures. The third type of resonator shows a less well-defined discontinuity near 25° C., whilst the relation between resonant wave-length and temperature is not linear. AUTHOR.

3317. Plasticity in Single Crystals. H. Schlechtweg. *Phys. Zeits.* 34. *pp.* 404–407, *May* 15, 1933.—Invoking the theoretical ideas of Prandtl and Polanyi, an attempt is made to explain qualitatively how plastic deformation can occur in a single crystal apart from any mosaic structure or small internal cavity. A process by which atoms suddenly change their positions in the crystal lattice is suggested, and the type of stress likely to give rise to the movement is specified. Experimental evidence in favour of the hypothesis is given. J. P. A.

3318. Deformation of Elastic Plasters. Parts III, IV, V and VI. E. Almansi. *Accad. Lincei, Atti*, 17. *pp.* 12–19, *Jan.* 8; 197–203, *Feb.* 5; 425–431, *March* 19, *and pp.* 776–783, *May* 21, 1933.—Applies mathematical methods to the determination of strains in cylindrical and other structures consequent upon stresses distributed in a given manner, and when they can be safely neglected. [For Parts I and II see Abstract 1705 (1933).] E. E. F. d'A.

3319. Plastic Properties of Unvulcanised Rubber Stocks at High Rates of Shear. J. H. Dillon and N. Johnston. *Physics,* 4. *pp.* 225–235, *June,* 1933.—An extrusion plastometer operating at rates of shear comparable with those existing in rubber tubing machines (10 to 1000 sec.$^{-1}$) is described. The relation between efflux rate and pressure at constant temperature for various types of rubber stocks was determined. For highly conpounded rubber stocks, such as tread stocks, the efflux rate *vs.* pressure curves attain linearity at low rates of shear. For lightly compounded stocks and for crude rubber, the curves are of the power function type at the lower rates of shear, but appear to attain linearity at the very high rates. These linear portions of the curves, for a given stock at different temperatures, are approximately parallel. Elastic recovery was determined as a function of rate of efflux. The extrusion plastometer is shown to be more sensitive to overmilling than is the Williams plastometer. The partial failure of the compression-type plastometer to correlate with the factory extrusion machine is explained on the basis of the much lower rates of shear employed in the compression-type instrument than those existing in the extrusion machine. AUTHORS.

3320. Vibrations in Rods and Discs. G. S. Field. *Canad. J. of Research,* 8. *pp.* 563–574, *June,* 1933.—A method is described for producing on the screen of a kathode ray oscillograph a curve showing the oscillations occurring in a rod or disc as the result of impact. These curves are usually quite complex, as they represent combinations of several different modes of vibration. They may be analysed, however, so that for any specimen the various component frequencies may be determined. This has been done for a great number of rods and discs, and the experimental frequencies so obtained have been compared with those calculated from theory. A discussion of the results is given. The solutions given by Love for the general equations of vibration applicable to transverse waves in cylindrical rods are examined, and it is shown that they do not apply to comparatively short rods. Other solutions of the same simple form are considered, and the conclusion is finally reached that a much more complex solution will be required to satisfy all the boundary conditions. AUTHOR.

3321. Strength of Thin Cylindrical Shells. W. M. Wilson and N. M. Newmark. *Univ. of Illinois Eng. Exp. Sta., Bull.* 255. *pp.* 1–45, *Feb.* 28, 1933.—Longitudinal compression tests are made upon iron and steel tubes, to investigate how the dimensions of the tube, its elastic properties, and the manner of loading, affect the "wrinkling" strength. It is found that the strength is proportional to t/R, where t is the wall thickness, R the radius of the tube, up to a critical value of t/R, after which the strength remains constant. The critical value differs for different materials. The effects of lengthening the cylinder, loading eccentrically, and including a transverse lap joint are investigated, and the character of the wrinkle at breakdown described in detail. Rules for the design of hollow cylindrical columns are then given. J. P. A.

3322. Strength under Alternating Load and Decay of Oscillations. M. Hempel. *Zeits. f. techn. Physik,* 14. 6. *pp.* 232–234, 1933.—A brief account of experiments investigating a possible relation between strength of steel under alternating load, and the damping of free oscillations in the material. The damping increases with the number of alternations of the load previously imposed on the specimen. No certain relation is found, however, by which the strength could be found from the damping. J. P. A.

See also Abstracts **3379, 3657, 3658, 3822.**

HYDRODYNAMICS AND AERODYNAMICS.

3323 Aerofoil in Wind Tunnel of Elliptic Section. L. Rosenhead. *Roy. Soc., Proc.* 140. *pp.* 579–604, *June* 1, 1933.—The lift and drag experienced by an aerofoil in a wind tunnel vary with the form of the tunnel due to the effects of the walls. The author has studied these effects in the case of a tunnel of elliptic section and has obtained the corrections which must be applied to the lift and angle of incidence induced on an aerofoil either by the rigid walls of an elliptic tunnel or by an open jet of elliptic section, when there is an elliptic distribution of lift over the aerofoil. H. Glauert's theorem on wind tunnel interference on small aerofoils is verified in the particular cases considered by the author. This theorem states that (*a*) the interference in an open tunnel of any shape is of the same magnitude, but opposite in sign, as that on the same aerofoil, rotated through a right angle in a closed tunnel of the same shape, and (*b*) the interference velocity is uniform across the span of an aerofoil in any elliptic tunnel having the tips of the aerofoil as foci. J. W. T. W.

3324. Ripples due to Circular Arcs. A. Weinstein. *Accad. Lincei, Atti,* 17. *pp.* 83–87, *Jan.* 8, 1933.—Calculates the angle made with the direction of propagation of an infinite cylinder in an infinite fluid of a ripple producing a line of discontinuity. E. E. F. d'A.

3325. Slow Motion of Fluid. W. R. Dean. *Phil. Mag.* 15. *pp.* 929–936, *May,* 1933.—The variation of pressure near an obstacle projecting normally from one of the walls forming a straight channel through which a fluid is flowing slowly is calculated approximately, and the result is applied to the estimation of the pressure which would be measured by a modified form of Pitot tube (having a rectangular orifice) placed near the boundary of a moving fluid. H. F. G.

3326. Skin Friction of Flat Plates. N. A. V. Piercy and H. F. Winny. *Roy. Soc., Proc.* 140. *pp.* 543–561, *June* 1, 1933.—In the present paper Abel's work is applied to obtain an approximate analytical solution in the form of a simple continuous function of the Reynolds number. The method is proved only for motions of appreciable magnitude, but comparison with a second order solution for small motions, which is also obtained, and with existing graphical evaluations shows that it applies with unimportant errors throughout the experimental range. Streamlines and other details of the flow are illustrated. A feature of large motions is a concentration of vorticity at the back edge of the plate, suggesting the eventual formation of an eddy there. At the large Reynolds numbers considered in the well-known Prandtl-Blasius theory the present solution reduces to the same form. Asymptotically, the resistance is found to be 70 % greater and the viscous boundary layer one-third thinner than calculated by Blasius from Prandtl's approximate equations. This indicates the ultimate importance of the inertia terms neglected by Oseen. Examination of careful experiments recently carried out by Hansen, however, suggests that the present theory may diverge somewhat less from observation than from Blasius' solution even near the limiting Reynolds number for steadiness, *viz.* 5×10^5. There appears need for further experiments at intermediate Reynolds numbers, when closer agreement between observation and the present solution might be expected.

AUTHORS.

3327. Hydrodynamic Resistance of Cylinders. K. Vogt and A. Becker. *Zeits. f. Physik,* 83. 3–4. *pp.* 164–170, *June* 14, 1933.—The constant velocity of fall of glass cylinders with hemi-spherical ends is investigated experimentally, the hydrodynamical resistance opposed to the fall of the cylinder measured and the results compared with those obtained by Wieselsberger [see Abstract 1936 (1922)]. It is desirable to extend the results to smaller values of Reynolds number than the smallest value [about 10] attainable, using water, in the present experiments. J. S. G. T.

3328. Maximum Force of Impact of a Body on the Surface of Water. F. Trey. *Phys. Zeits.* 34. *pp.* 494–495, June 15, 1933.—Attention is directed to work by Neureiter [*Deutsche Z. f. d. gesamte gericht. Medizin* 16, H. 4] and by Trey [*Acta Universitates Latviensis. Mat. Ser.* 1. 247, 1931] the results of which agree with those of Watanabe relating to the impact of a cone upon a water surface. J. S. G. T.

3329. Theory of Turbulence in Canals. G. D. Mattioli. *Comptes Rendus,* 196. *pp.* 1282–1284, *May* 1, 1933.—Purely mathematical.

H. F. G.

3330. Dimensional Analysis of Turbulent Flow. R. Esnault-Pelterie. *Comptes Rendus,* 196. *pp.* 1968–1970, *June* 26, 1933.—The theory of dimensions, applied to results obtained from the flow of water through orifices of 1–2 mm. dia. in tubes of length 4–40 mm. has established the existence of two new types of turbulent flow, in which one of the constants entering into the theoretical formula is, or is not, respectively dependent upon the roughness of the wall of the tube. J. S. G. T.

3331. Non-Uniform Flow of Water. F. V. A. E. Engel. *Engineer,* 155. *pp.* 392–394, *April* 21; 429–430, *April* 28, *and pp.* 456–457, *May* 5, 1933.—Experiments with a Venturi flume formed by reduction of the section of a rectangular channel indicates that, in general, flow in open channels is characterised by the Reynolds and Boussinesq numbers. The latter is a dimensionless quantity given by $B = v/\sqrt{gr}$, where v is the mean velocity, g the acceleration due to gravity and r the mean hydraulic radius $= 2bd/(2d + b)$, where b and d are the breadth and depth of the wetted part of the channel. Laminar flow existed far beyond the critical Reynolds number (1160) to values up to 20,000, owing to the stabilising influence of the Venturi inlet; turbulent flow occurred at Reynolds numbers above 40,000. Model tests in the turbulent region are complicated by the functional relations between the hydraulic coefficients and the Reynolds and Boussinesq numbers. The region of rapid flow, characterised by the appearance of a standing wave, is defined by reference to the critical Boussinesq number. The ordinary equation for the depth below which rapid flow exists usually gives low values, but is nevertheless applicable to free discharge. In the region of rapid flow a suitably designed Venturi flume gives readings as accurate as those obtained with carrier ring orifices or Venturi tubes in pipe lines. H. F. G.

3332. Currents in Neighbourhood of an Air Screw. J. Valensi. *Comptes Rendus*, 196. *pp*. 1639–1641, *May* 29, 1933.—Describes a stroboscopic method for studying the distribution of currents in the neighbourhood of an air-screw turning at 34·5 r.p.s. The spiral eddy, as it leaves the tip of the blade and travels back, closes in slightly on the axis of the screw. This effect is shown in a photograph reproduced in the paper. J. W. T. W.

3333. Currents Produced by a Marine Screw Propeller. C. Chartier. *Comptes Rendus*, 196. *p*. 1642, *May* 29, 1933.—The author has photographed the lines of flow in the neighbourhood of a three-bladed screw propeller. Behind the screw the lines follow conical spirals; ahead of it they are practically parallel to the axis except quite close to the screw. J. W. T. W.

3334. Variation of Angle of Constriction in Fluid Flowing past an Obstacle. L. Sackmann. *Comptes Rendus*, 196. *pp*. 1716–1718, *June* 6, 1933.—A continuation of previous work [see Abstract 881 (1933)], using a short cylindrical obstacle between parallel glass plates to study the conditions of flow. The angle of constriction varies with the rate of flow and photographs are reproduced to show the various conditions that are met with at different velocities. J. W. T. W.

3335. Optical Determination of the Direction of Motion of Air Streams. A. Magnan. *Comptes Rendus*, 196. *pp*. 999–1001, *April* 3, 1933.—Methods based on refraction are ordinarily inapplicable except at high air velocities. A point source of light is focussed by an unsilvered glass mirror of 3 m. radius of curvature on to a ground glass screen or a photographic plate. If the current of warm air above a heated object is allowed to pass through the path of the rays between the mirror and screen it becomes visible on the screen. The method has been applied to the study of the movement of air around a cylinder and the wings of birds and insects. H. F. G.

3336. Dimensional Homogeneity Applied to the Standard Orifice. H. W. Gardner. *Mines Mag*. 23. *pp*. 5–7, *April*, 1933.—The principle of dimensional homogeneity is applied to the calculation of the time-rate of discharge from a standard orifice with the object of investigating the influence of such factors as viscosity, density, elasticity, turbulence, surface tension, and head of liquid on the coefficient of discharge. H. F. G.

3337. New Indicator of Angle of Attack. M. Roger. *Comptes Rendus*, 196. *pp*. 1467–1470, *May* 15, 1933.—A device is described for determining the angle of attack of an aeroplane or the angle of incidence of a wind, and comprising manometric capsules arranged in a pair of orifices in a cylinder and connected respectively with electrical resistances provided with means for indicating the ratio of the currents in the two resistances. J. S. G. T.

3338. Comparison of Pitot Dynamic Tubes. Leroux. *Comptes Rendus*, 196. *pp*. 1778–1780, *June* 12, 1933.—Experimental results with a Pitot tube using one of six forms of dynamic tube agree to within 1 % when used for the measurement of velocities of the order 2·7–10·3 m./sec. When greater accuracy is required, a form of tube ending in an ogive curve is preferable to a tube with a conical end. The accuracy obtainable with tubes of the former kind is to the order of a few 10,000ths. J. S. G. T.

KINETIC THEORY OF MATTER.

3339. Mean Free Path in Rare Ionised Gases. V. C. A. Ferraro. *Roy. Astron. Soc., M.N.* 93. *pp.* 416–422, *April*, 1933.—In calculating the mean free path the author abandons the usual assumption that the particles are neutral; and defines the mean free path alternatively by a comparison of the formulæ for the coefficient of diffusion and by the time for deflection through a specified angle. In the latter case the cumulative effect of feeble encounters is considered, but not in the first instance encounters between the electrons themselves. The formulæ derived from the two definitions are approximately the same. The modification introduced where collisions between like particles are important (viscosity) is considered. If the temperature is high, or if the proportion of neutral to ionised atoms is comparatively large, the mean free path approximates to that derived on the neutral particle assumption. In other circumstances it is much shorter. T. L. M.

3340. Relativistic Partition of Energy in Gases. P. E. Böhmer. *Phys. Zeits.* 34. *pp.* 454–456, *June* 1, 1933.—A mathematical calculation of the energy distribution in an ideal gas, using relativity mechanics.
J. H. A.

3341. Effect of Heat Flow on Brownian Motion. K. Sitte. *Zeits. f. Physik*, 83. 3–4. *pp.* 266–269, *June* 14, 1933.—Satô has asserted [see Abstract 2197 (1933)] that a heat flow changes the mobility of a particle and consequently influences the Brownian motion. It is shown that these deductions arise from errors in Satô's calculations. The method of Zeilinger which Satô used is shown to be inapplicable to this case. J. E. K.

See also Abstracts 3283, 3307, 3384, 3697, 3781.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3342. Simple Method for the Numerical Solution of Differential Equations. W. G. Bickley. *Phil. Mag.* 15. *pp.* 1174–1177, *June*, 1933. —A method of testing the solutions of differential equations obtained by the method developed in a previous paper [see Abstract 3555 (1932)] is given. The method enables the error to be determined at any stage of the calculation and involves the differencing of small numbers to the second order only. J. S. G. T.

3343. Calculation of Statistical Averages for Perturbed Systems. R. Serber. *Phys. Rev.* 43. *pp.* 1011–1021, *June* 15, 1933.—A general expression is derived for the statistical mean value of any function of dynamical variables, averaged over all the molecules of a gas in the presence of external fields. This expression is in the form of a multiple Taylor's series in powers of $1/kT$ and of the field strengths. Explicit formulæ, valid for diatomic and polyatomic molecules, are given for the coefficients in this series, up to and including the cubic terms. The general formulæ is then applied in the solution of two specific problems: (1) Effect of a magnetic field on the electric susceptibility of a molecule; (2) theory of the Kerr effect in diatomic and polyatomic molecules. The concluding sections give applications of the formulæ to the perturbation theory of conservative and non-conservative systems. AUTHOR.

3344. Probability, Statistics and the Theory of Errors. H. Jeffreys. *Roy. Soc., Proc.* 140. *pp.* 523–535, *June* 1, 1933.—The process of generalising from observational data is necessary to the greater part of scientific method. A theory of this process cannot be constructed from logic and observation alone, but requires an *a priori* postulate incapable of proof from logic and observation. It is necessary to have such a postulate or to reject scientific inference altogether. It is impossible to disprove the possibility of deriving the whole of science from *a priori* considerations without reference to observation; but there seems to be no convincing reason for believing it, and the domain of such a method is in any case too restricted for general application. The theory of probability provides a primitive postulate capable of serving as a foundation for an adequate theory of generalisation from experience. Objections to the theory all seem to arise from failure to apply its rules correctly. In particular the objection to the assessment of a probability without previous observational knowledge amounts to the statement that ignorance cannot be described, which seems clearly untrue. Fisher's theory rests on incorrect premises and his fundamental definition is mathematically meaningless. The later development confuses the known and the unknown, and makes it impossible to allow for previous relevant knowledge. AUTHOR.

3345. Sources of Error in Statistical Analysis. A. G. McNish. *Frank. Inst. J.* 215. *pp.* 697–703, *June*, 1933.—Seven frequently overlooked sources of error in the statistical analysis of periodicities are discussed and illustrations of them are drawn from recent published discussions of cosmic-ray observations. It is shown that, through non-observance of several principles of statistical analysis, many investigators have reached incorrect conclusions as to the reliability of the periodic variations which they have deduced from their observational results. The data taken by Bennett, Stearns, and Compton on Pike's Peak, September, 1931 [see Abstract 4499 (1932)], are tested by a criterion different from that which was employed by the original investigators, from which the conclusion is drawn that the variations they observed are attributable to accidents of observation. AUTHOR.

3346. Electrical Calculating Machine. R. R. M. Mallock. *Roy. Soc., Proc.* 140. *pp.* 457–483, *May* 3, 1933.—The machine is designed to provide a solution of sets of algebraic simultaneous equations with many unknowns. It consists essentially of a set of a.c. transformers each with a number of windings the unknown being proportional to the number of turns in the windings and it can be operated from ordinary a.c. mains. The present machine can deal with ten equations and, with an improved design, and the use of better materials, errors in the roots have been reduced in favourable cases to below 0·1 % of the largest root. The theory of the method of operation of the machine is given and details of its construction. Errors arise in the operation of the machine (1) from resistance drop due to the current in the coils, and (2) from stray flux and capacity effects. The former is reduced by either a series of approximations made by the operator, or by corrections being applied automatically. The errors due to capacity between the various coils on the transformers are found to be too small to be appreciable. With certain small additions the machine can be used for the direct solution, by the method of least squares, of a set of equations of condition without forming the normal equations. R. S. R.

3347. New Logarithmic Calculating Machine. H. Fuss. *Zeits. f. Instrumentenk.* 53. *pp.* 207–220, *May, and pp.* 257–266, *June,* 1933.—The author sets out to obtain a machine suitable for large scale use with formulæ which combine multiplication, division, powers and roots, trigonometrical and ordinary numbers. The manipulation must be as simple as possible without the necessity for complicated rules and an accuracy of 0·025 % is desired. The machine must be of the logarithmic slide type. These requirements are met by having the logarithmic numbers on steel bands moving on rollers as in a kinematograph and each band travels under a window with index graduations. A loose coupling allows each band to be moved independently or two together. With this arrangement long strips can be used and the instrument is still compact. Two scales are used for logarithmic tangents (21″ to 89° 59′ 39″) and sines (21″ to 90°), two for reciprocals, 10^{-4} to 10^4, and a fifth scale for ordinary logarithmic numbers. The five bands travel side by side. Full mechanical details of the machine and diagrams are given and the sources of error and their elimination explained. Finally examples are given of six fundamental tasks in spherical trigonometry for which the instrument can be used. R. S. R.

3348. Logarithmic Protractor. H. J. Yearian. *Rev. Sci. Instruments,* 4. *pp.* 407–409, *July,* 1933.—Describes a protractor designed to convert microphotometer records to photographic density, according to the relation $D=\log (i_0/i)=\log (d_0/d)$ where i_0 and i are the incident and transmitted microphotometer intensities and d_0 and d are the corresponding deflections on the record. It consists of a parallel ruler along which runs a carriage carrying the plotting pencil. The carriage is operated by a flexible cable passing around a drum which rotates around a vertical axis perpendicular to the ruler. This axis also carries a template cut according to the curve $\log \rho = a\theta$, having as origin the axis of the drum. A zero line is fixed parallel to the ruler and also passes through the common axis of the drum and template. J. S. C.

See also Abstracts 3352, 3353, 3354, 3669, 3808, 3841.

MECHANICS, CLASSICAL.

3349. Funicular Surfaces. L. Lecornu. *Comptes Rendus,* 196. *pp.* 1553–1557, *May* 22, 1933.—In a former paper [see Abstract 3631 (1930)] the form of a plane network of infinitely small square mesh, composed of flexible, inextensible filaments fastened between two points, as in the case of a funicular surface, was investigated when external forces of the same magnitude as the linear elements were applied to them. Under such conditions the mesh is formed of infinitesimal rhombs whose angles vary generally in passing from one point to another. In the present paper some purely geometrical properties of the funicular surface are examined mathematically, and values are found for the surface curvature under certain defined conditions. R. S. R.

3350. Lines of Force of Symmetric Newtonian Potentials. I. Opatowski. *Accad. Sci. Torino, Atti,* 68. 2, *pp.* 135–146, *and* 68. 3. *pp.* 359–363, 1933.—The equations of the lines of force are obtained for a potential field with axial symmetry, and the results are applied to the problem of the axial magnetisation of the ellipsoid of rotation. A. J. McC.

3351. Generalisation of Euler's Theorem on Brachystochrone Movements. C. Carathéodory. *Accad. Lincei, Atti,* 17. *pp.* 10–12, *Jan.* 8, 1933.—Shows that a generalised Euler theorem of brachystochrones or lines of shortest time may be derived from the principle of Maupertuis in Jacobi's form. E. E. F. d'A.

3352. Euler-Savary Formula. R. S. de Beires. *Accad. Lincei, Atti,* 17. *pp.* 637–640, *April* 23, 1933. *In French.*—The author shows mathematically how the Euler-Savary formula can be established rapidly for the motion in rigid planes and then extends this to rigid spherical motions by a simple consideration of plane perspective. R. S. R.

3353. Method of Spectral Reduction in Classical Dynamics. A. Khintchine. *Nat. Acad. Sci., Proc.* 19. *pp.* 567–573, *May,* 1933.—Reference is made to papers by Koopman and Neumann [see Abstracts 2305 and 2306 (1932)] in which proofs were obtained of a series of general and interesting theorems of classical dynamics by means of a new method based on spectral reduction of unitary operators in the Hilbert space. These methods were based on Stone's theorem of the possibility of spectral reduction of any unitary operator. The author uses a theorem of Bochner expressed in the form: " In order that the function $f(x)$ of the real variable x be representable in the form $f(x) = \int_{-\infty}^{+\infty} e^{i\alpha x}\, d\,\mathrm{F}(\alpha)$, where $\mathrm{F}(\alpha)$ is a non-decreasing function of bounded variation, it is necessary and sufficient that it be positive-definite; this means that it must be bounded and continuous in $(-\infty, +\infty)$ and that the integral $\int_a^b\int_a^b f(y-z)\,\phi(y).\,\overline{\phi}(z).dy.dz$ must be non-negative for any real a and b if $\phi(x)$ be any continuous complex function of the real variable x." It is shown mathematically that the most important of the results of Koopman and Neumann may thus be obtained by an elementary spectral analysis without applying the theory of operators. R. S. R.

3354. Semi-Continuity of Enclosure of the Trajectories of Dynamics. Marie Charpentier. *Comptes Rendus,* 196. *pp.* 1771–1773, *June* 12, 1933.—The object of the paper is to show that certain ideas can be related to the view of semi-continuity of enclosure as it has been stated by Bouligand. Examples of this are given and applied to molecular motions. R. S. R.

3355. Photographic Recording of Oscillatory Motion. E. Raetsch. *Zeits. f. Instrumentenk.* 53. *pp.* 283–285, *June,* 1933.—A simple optical arrangement is described whereby an oscillatory motion in two perpendicular directions may be recorded satisfactorily on a moving photographic film. J. P. A.

See also Abstract 3360.

MECHANICS, QUANTUM.

3356. Penetration of Electrons into the Region of Negative Energy Values. S. Szczeniowski. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3A. *pp.* 21–39, *Jan.–March,* 1933. *In German.*—The Brillouin-Wentzel method for the approximate calculation of wave functions in the one dimensional case is applied to the Dirac wave equation for electrons moving in a potential field $\mathrm{P}(x)$ of the form:

$P(x) = \text{constant} = P_1$ for $x < x_1$,
$P(x) = \text{constant} = P_2$ for $x > x_2$ $(P_2 > P_1)$,
$P(x)$ = any monotonic increasing function of x rising from P_1 to P_2 for $x_1 < x < x_2$.

The author considers electrons moving in the direction of increasing x and having total energy W such that: $\frac{W - P_1}{mc^2} > 1$ and $\frac{W - P_2}{mc_2} < -1$. Thus these electrons have positive energy in excess of the rest mass energy for $x < x_1$, and negative total energy for $x > x_2$. The probability that such electrons will penetrate into the region $x > x_2$ is computed and it is shown that this probability can have appreciable values only if the average rate of increase of $P(x) - P_2 - P_1/(x_2 - x_1)$ is sufficiently great, *i.e.*, of the order of $2mc^2/(h/mc) = 2m^2c^3/h$. This confirms a general prediction due to Bohr. W. S. S.

3357. Theory of Scattering by a Force Centre. E. H. Kennard. *Nat. Acad. Sci., Proc.* 19. *pp.* 518–521, *May*, 1933.—A mathematical note establishing, in the general case, the orthogonality of eigenfunctions representing plane waves falling upon a force centre and being scattered by it. W. S. S.

3358. Conservation of Probability and Energy as Criteria for the Validity of Wave Equations. A. Lees. *Phil. Mag.* 15. *pp.* 1133–1142, *June*, 1933.—There are two conditions which a wave equation should satisfy, one corresponding to the conservation of probability, the other expressing a relation which, in the case in which the Hamiltonian does not involve the time explicitly, corresponds to the conservation of energy. It is known that the first condition is satisfied by Schrödinger's non-relativistic equation and by Dirac's equation, but not by the second-order relativistic equation. The author proves that the second condition also is satisfied in the same two cases. These facts seem to provide a stronger reason for rejecting the second-order relativistic equation than those usually given. One of the author's results disagrees with Landé's work [see Abstract 2271 (1928)] and the source of his error is indicated. AUTHOR.

3359. Theory of Perturbation and the Eigenvalue Problem of an Anharmonic Oscillator. K. Basu. *Indian Phys. Math. J.* 4. *pp.* 1–8, *April*, 1933. *In English.*—A perturbation theory based on wave-mechanical concepts is developed. The characteristic function of a problem whose solution is known (the unperturbed problem) is expressed in terms of a known polynomial and the characteristic function of the perturbed problem is expressed in terms of a convergent series of such polynomials. The ultimate result depends on the solution of the resulting determinental equation of infinite order for the eigenvalue θ, so that perturbations up to any desired order can be found. The method is applied to the perturbation effect in the energy value of a diatomic molecule. The limitation of the method is that the eigenvalue calculation is valid only when the quantum number in the energy value of the oscillator is not very great. N. M. B.

3360. Quantum Mechanics of the Anharmonic Oscillator. G. Pöschl and E. Teller. *Zeits. f. Physik*, 83. 3–4. *pp.* 143–151, *June* 14, 1933.—The significance of the uni-dimensional anharmonic oscillator in the derivation of the potential function Δr (V) relating to spectra, in accordance with the principles of classical and quantum mechanics is discussed. Forms of V which render Schrödinger's equation exactly integrable are discussed, and energy levels and spectral frequencies corresponding to various forms of V are derived. J. S. G. T.

3361. Relativistic Two-Body Problem. O. Scherzer. *Zeits. f. Physik,* **83.** 5–6. *pp.* 277–283, *June* 20, **1933.**—The wave-equation for two attracting particles is set up, account being taken of the relativity correction. G. C. McV.

3362. Validity of the Virial Law in the Thomas-Fermi Theory. H. Jensen. *Zeits. f. Physik,* **81.** 9–10. *pp.* 611–624, *April* 7, **1933.**—Exception is taken to the method used by V. Fock (*Phys. Zeits. d. Sowjetunion,* **1.** 497, **1932.**) to establish a relationship between the kinetic and the potential energy of a Fermi electron-gas in the field of fixed nuclei, which Fock calls the " Virial law of the Thomas-Fermi theory." The present author modifies Fock's procedure and so avoids his difficulties. He obtains a satisfactory formulation of the virial theorem. H. L. B.

3363. Relativistic Treatment of the Fermi Atom. H. Jensen. *Zeits. f. Physik,* **82.** 11–12. *pp.* 794–802, *May* 30, **1933.**—The relativistic Thomas-Fermi equation is deduced and discussed. It gives a result which has a meaning only if we take into account that the potential of the nucleus is not a Coulomb-potential right up to $r = 0$ but deviates from it in the manner given by the theory of radioactivity. An estimate of the relativistic distribution of charge shows that within a sphere of radius about 10^{-11} to 10^{-10} cm. it exceeds the Fermi distribution by a charge of less than one electron on the whole and that outside this radius it deviates to the same extent in the opposite direction. H. L. B.

3364. Quantum Statistics of Almost Classical Assemblies. J. G. Kirkwood. *Phys. Rev.* **44.** *pp.* 31–37, *July* 1, **1933.**—The sum of states of an assembly in statistical equilibrium may be transformed into an integral in phase space, which is analogous to the classical Gibbs phase integral. With the use of an equation obtained by Bloch it is possible to expand the quantum phase integral in powers of Planck's constant h. The present method of treating the problem supplements that of Wigner and of Uhlenbeck and Gropper by furnishing a more convenient means of obtaining the h-expansion. AUTHOR.

See also Abstracts **3296, 3343, 3371, 3372, 3474, 3806.**

RELATIVITY AND ETHER.

3365. Combination of the Equations of Newton, Fresnel and Maxwell. E. Sevin. *Comptes Rendus,* **196.** *pp.* 1379–1381, *May* 8, **1933.**—In matter as well as in a vacuum, the law of gravitation brings in the mean curvature of the universe. In a vacuum this curvature is zero, and if, in a given region, the ether is displaced by a quantity u, we have immediately the equation $\delta^2 u/\delta t^2 = c^2 \Delta u$. Δu is nothing but the mean curvature, and if this curvature is zero, there is a simple gravitational field ; if it is not, a phenomenon which propagates itself is superimposed on the gravitational field ; it is the unpolarised electromagnetic wave which has no vectorial properties. Quantity of movement being proportional to quantity of electricity, it follows that the divergence of the latter is zero, like the former. Thus, polarised electromagnetic vibrations consist of real electric currents, and, in order to interpret them completely, we must employ a double vectorial representation including the work of both Fresnel and Maxwell. E. E. F.d'A.

3366. Absolute Motion of Solar-System and Orbital Motion of the Earth by the Ether-Drift Experiment. D. C. Miller. *Science*, 77. *pp.* 587–588, *June*, 1933. *Rev. Modern Physics*, 5. *pp.* 203–242, *July*, 1933.—The author claims to have demonstrated, by means of the Michelson-Morley experiment, that the solar system is moving relatively to the ether with a velocity of 208 km./sec. towards the apex: R.A. 4h. 56m., Dec. 70° 30′ South. The displacement of the interference fringes, however, corresponds to a velocity of one-twentieth of that given. G. C. McV.

3367. Measurement of Spatial Distance in a Curved Space-Time. H. S. Ruse. *Roy. Soc. Edinburgh, Proc.* 53. 1. *pp.* 79–80, *and* 53. 2. *pp.* 81–88, 1932–1933.—A definition of spatial distance is given, which, it is claimed, corresponds to that determined by the use of rigid measuring rods. The formula derived for spatial distance corresponds with that given in the author's previous paper [see Abstract 3587 (1932)] and with that derived from Whittaker's definition of spatial distance [see Abstract 347 (1932)]. J. S. G. T.

3368. Incompatibility of the Riemannian Concept of Space with the Principle of Relativity. J. le Roux. *Comptes Rendus*, 196. *pp.* 1714–1716, *June* 6, 1933.—Incompatibility of the Riemannian concept of space with the principle of relativity is demonstrated from considerations of superposability and the theory of invariants. In particular, the requirements of the principles of relativity cannot be satisfied by the postulation of an interval, ds^2, of space time. J. S. G. T.

3369. Unitary Principle Linking Relativity, Gravitation and the Discreteness of Quanta. A. Press. *Phil. Mag.* 15. *pp.* 1143–1153, *June*, 1933.—It is shown that the Kaufmann-Bucherer experiments really prove that in addition to a resultant modification of the electrical force effect at a distance, due to a moving charge q, satisfying the classical equation (Heavisidean), $q = q_0\left(1 - \frac{1}{3}\frac{v^2}{c^2}\right)$, that there is similarly a resultant modification of the gravitational force at a distance which can be expressed by a (so-called Einsteinian) relation $m_e = m\left(1 - \frac{1}{4}\frac{v^2}{c^2}\right) \equiv m(1 - \sqrt{1 - \beta^2})$. Both effects substantiate the author's theory that at right angles to the usual central force system P, gravitationally and electrically, there exists a Q force which depends in magnitude on the time rate of change of the radius vector. Thus no need is found for deviating from Newton's conceptions of time, space and mass, either astronomically or electronically. In fact, with the author's gravitational equation, better agreement is achieved astronomically than with the Einsteinian. The new theory is not only fruitful in furthering the correlation between Einstein's ideas and classical theory, but it actually leads, as a matter of course, to Bohr's conception of discrete orbital states. Moreover, for the order of atomic distances discussed by Sommerfeld and Kratzer, the force function naturally reduces to the theoretically derived form $F = \frac{dV}{dr} = P\left(1 - \frac{C_3}{r^3} + \frac{C_5}{r^5}\right)$. The second and fourth inverse powers do not occur at all. This is in keeping with the experimental deductions of Born and Heisenberg. AUTHOR.

3370. Contraction of the Universe. E. Sevin. *Comptes Rendus*, 196. *pp.* 1783–1785, *June* 12, 1933.—It is shown that, with certain appropriate assumptions regarding the state of the matter in the universe, a spherical universe whose radius is decreasing is compatible with red-shift of the spectral lines in the light from distant objects in the universe. G. C. McV.

3371. Geometry of Four Component Spinors. O. Veblen. *Nat. Acad. Sci., Proc.* 19. *pp.* 503–517, *May*, 1933.—This paper is the first of a series in which a geometrical theory of spinors will be developed. The basic idea is to use the Pluecker-Klein correspondence between the lines of a projective 3-space and the points of a quadric in a 5-space. W. S. S.

3372. Theory of Spinors. K. Nikolsky. *Zeits. f. Physik*, 83. 5–6. *pp.* 284–290, *June* 20, 1933.—It is shown that the theory of spinors can be expressed as a line-geometry. G. C. McV.

See also Abstracts 3340, 3404.

SOLUTION.

See Abstract 3769.

SURFACE TENSION AND COHESION.

3373. Magnitude of Liquid Droplets on the Surface of the Same Liquid. L. D. Mahajan. *Zeits. f. Physik*, 81. 9–10. *pp.* 605–610, *April* 7, 1933.—In continuation of the previous work [see Abstract 899 (1933)], the conditions governing the size of the droplets have been examined. With increase of the size of the burette opening the primary droplet becomes larger, but the secondary droplet is unchanged; the sizes of both are greater for liquids of higher surface tension, but are independent of the viscosity and density of the liquid. Large drops (diameter 1·24 cm.) may be formed by coalescence of smaller drops, particularly in the case of soap solutions, but their life is very short. H. F. G.

3374. Oil-Water Contact Surfaces. J. J. Trillat and L. Leprince-Ringuet. *Comptes Rendus*, 196. *pp.* 1214–1216, *April* 24, 1933.—The interfacial tension of pure paraffin oil and water, as determined by the platinum-ring method, is 40 dynes/cm., but on adding a few drops of oleic acid of concentration 10^{-2} or 10^{-3} the tension falls abruptly. Cyclohexanol, which possesses a permanent electric moment, produces such a fall, whereas cyclohexane does not. It is possible to discover a hundred-thousandth part of an active impurity in paraffin oil by a study of its surface tension. Heat and ultra-violet light have a marked effect upon it. E. E. F. d'A.

3375. Surface Tension Studies with *n*-Butyl Acetate. E. R. Washburn and C. H. Shildneck. *Am. Chem. Soc., J.* 55. *pp.* 2354–2357, *June*, 1933.—The surface tension of *n*-butyl acetate at 20·0, 25·0, 30·0, 35·0° has been determined. Values of the Eötvös constant and of the parachor indicate that the ester is a "normal" liquid. The equilibrium values for the surface tensions of aqueous solutions of *n*-butyl acetate have been determined at 25·0°. Semi-quantitative evidence seems to indicate that the surface layer in solutions of this type must be many molecules in thickness. AUTHORS.

3376. Interfacial Tension of Mercury in Contact with Organic Liquids. F. E. Bartell, L. O. Case and H. Brown. *Am. Chem. Soc., J.* 55. *pp.* 2419–2426, *June,* 1933.—The measurement of interfacial tension of pure liquids against mercury with both the drop weight method and the capillary rise method gave results showing close agreement, indicating that either the dynamic method or the static method is suitable for such measurements. Some of the results obtained did not show close agreement with generally accepted values in the literature. Interfacial tension values were obtained for certain halogen derivatives against mercury. These values are higher than those previously recorded. Interfacial tension values were obtained for some liquids against mercury for which no data are given in the literature. Data obtained for an homologous series of organic liquids against mercury indicated that, in the absence of solubility effects, the interfacial tension values of the members of an homologous series against a given liquid will decrease progressively if the surface tension values of the organic liquids increase progressively in the series. AUTHORS.

3377. Boundary Angle Measurements. Part II. O. Herstad. *Kolloid Zeits.* 64. *pp.* 6–12, *July,* 1933.—Over 1000 measurements have been made by means of the earlier described apparatus [see Abstract 2906 (1931)] of drops of volatile liquids such as the various brands of benzene. It was established generally that the boundary angle alters continuously until the disappearance of the drop, thereby invalidating the Laplace law of constancy of boundary angle; in consequence for the latter term a change to boundary angle index is proposed. The effects of temperature changes of the glass support and also of its previous history are discussed, and quartz glass is recommended for obtaining the best conditions possible for comparable results. H. H. Ho.

3378. Surface-Tension Measurements of Solutions of Sodium and Potassium Salts of the Higher Fatty Acids by Means of the Ring-Rupture Method. Parts I and II. A. Lottermoser and E. Schladitz. *Kolloid Zeits.* 63. *pp.* 295–304, *June, and* 64. *pp.* 44–49, *July,* 1933.—The surface tensions of pure sodium-soap solutions have been measured and correlated with respect to temperature and concentration, and compared for a temperature just above the melting point of the fatty acid concerned, since the measurements below the melting part are badly reproducible. The minimum surface tensions whose values do not deviate much from each other for the soaps investigated, extend over a concentration-range which increases from laurinate to palmitate; the richer the fatty acid is in carbon, the smaller the concentrations necessary for attainment of the minimum. The potassium soaps exhibit similar phenomena, while the measurements are reproducible at temperatures 10–20° below the melting-point. Mixtures of different potassium soaps give an additive surface tension in every concentration-range, when the fatty acids possess equal C-atom numbers. The titration of fatty acids by sodium hydroxide accompanied by surface tension measurements gave the result that the equivalent point in dilute solutions occurred on the descending branch of the titration curve, while in more concentrated solutions it coincided with the surface-tension minimum, and in very concentrated solutions fell on the second ascending branch. The measurements indicate how excess of either fatty acid or alkali influence the surface tensions of soap solutions of varying concentrations. With mixtures of fatty acids, the one of lower molecular weight is neutralised first. The du Noüy minima at extreme dilutions could not be detected; at dilutions so great, a soap behaves like the corresponding free fatty acid. By addition of traces of soaps, acids could be titrated with alkalies, the surface tension serving as indicator. H. H. Ho.

3379. Equation of State for Monomolecular Films. J. Guastalla. *Comptes Rendus*, 196. *pp.* 1376–1378, *May* 8, 1933.—The surface pressure in a monomolecular film on water is due to three causes, (*a*) thermal agitation, (*b*) electrostatic repulsion between molecular dipoles, and (*c*) modification of the interfacial tension between the film and the water. A brief discussion leads to the equation of state $P = \frac{A}{l^5} - \frac{B}{l^3} + \frac{C}{l^2}$, where the terms with coefficients A, B and C are due respectively to the causes (*b*), (*c*) and (*a*), and l^2 is the mean area occupied by one molecule in the surface. J. P. A.

3380. Adhesion Tension. F. E. Bartell and H. J. Osterhof. *J. Phys. Chem.* 37. *pp.* 543–552, *May*, 1933.—An account is given of preliminary work carried out in the development of methods for the determination of adhesion tension data [see Abstract 3080 (1932)]. The pressure of displacement method is described in considerable detail and data for a series of liquids against silica and against carbon are included. H. H. Ho.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

3381. Apparent Lunar Effect in Time Determinations at Greenwich and Washington. A. L. Loomis and H. T. Stetson. *Roy. Astron. Soc., M.N.* 93. *pp.* 444–448, *April*, 1933.—Published comparisons of daily time-signals were solved for the difference in corrected times and for time of propagation of radio waves across the Atlantic. Both were analysed against the moon's hour-angle in three groups, moon south, near equator, and north. No systematic effect in propagation time is shown. A systematic effect in time difference appears for moon north and south, the two curves being inverted; for moon near equator any systematic effect is much smaller; in the former case the variation is 0·12 sec. T. L. M.

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3382. Performance of Relays. G. A. Tomlinson. *Journ. Sci. Instruments*, 10. *pp.* 204–208, *July*, 1933.—Three types of relay have been investigated as regards variability in the time of operation, a factor which is of importance in accurate time measurement. Of two standard commercial types, the rocking armature was found definitely superior to the moving coil. The third relay tested was an experimental reed armature type, specially designed for very rapid action, and the lag of this relay was found too small to be measured, *i.e.*, not exceeding 0·1 millisecond. AUTHOR.

See also Abstract 3394.

VACUA, HIGH.

3383. Barostat. F. A. Gould and J. C. Evans. *Journ. Sci. Instruments*, 10. *pp.* 215–218, *July*, 1933.—A new form of apparatus for controlling the pressure in large vacuum chambers is described. The controlled pressure can be adjusted to any value within the range 20–860 mm. (1–34 in.) of mercury, and can be maintained for an indefinite period.

Under the best conditions of adjustment, fluctuations of the controlled pressure about a mean value are less than 0·005 mm. of mercury. AUTHORS.

VISCOSITY, FRICTION AND LUBRICATION.

3384. Viscosity of Homogeneous Fluids. R. O. Herzog and H. Kudar. *Zeits. f. Physik*, 83. 1–2. *pp.* 28–42, *June* 6, 1933.—A theoretical treatment based on Jäger's equation $\eta = P\,\sigma/\omega$ and on that of Batschinskis $\eta = C/(\nu - \omega)$ where η is the viscosity, P the internal pressure, and σ a coefficient connected with the mean molecular diameter, ω the molecular velocity, C a constant and ν the specific volume. Jäger's equation takes no account of molecular rotation, and Batschinskis' is empirical. The investigations given in the paper make allowance for the rotation, and also for the size and form of the molecule. J. H. A.

3385. Anomalous Viscosity of Segregating Systems. Part I. Structural Viscosity of Liquid Mixtures at the Critical Point [of Miscibility]. Part II. Structural Viscosity of Mesomorphic Melts. W. Ostwald and H. Malss. *Kolloid Zeits.* 63. *pp.* 61–77, *April, and pp.* 192–203, *May*, 1933.—Measurements with a Tsuda type of capillary viscometer show that saturated sugar solution, molten glucose, lauric and stearic acids, sodium acetate (trihydrate), benzophenone, and naphthalene conform to the Hagen-Poiseuille law, whilst the report of Scott-Blair and Schofield, that concentrated lithium chloride solutions exhibit structural viscosity, could not be confirmed. Study of a number of binary mixtures and one tertiary mixture of partly miscible liquids indicates that at the critical point structural viscosity, *i.e.*, rapid increase of the viscosity at small rates of flow, appears. The significance of this observation is discussed at length; Ostwald's view that liquid mixtures at the point of critical miscibility are emulsoid systems of an approximately colloidal degree of dispersion is strongly supported. The viscosity changes of certain mesomorphic substances, *viz.*, ethyl-p-azoxybenzoate and cholesteryl-acetate, propionate, and butyrate have been studied. In all cases structural viscosity is apparent in the interval between clearing point and crystallisation point; characteristic changes of colour and opacity appear simultaneously. It is concluded that such systems are of the same type as segregating binary liquid mixtures. H. F. G.

3386. Viscosity of Barium Chloride in Aqueous Solution. G. R. Hood and L. P. Hohlfelder. *Physics*, 4. *pp.* 208–210, *June*, 1933.—Measurements are made on the viscosity of aqueous solutions of barium chloride at 18° C. over the range 0·006 to 0·492 molality. The value of the constant A in the equation $\eta = \eta_e/\eta_0 = 1 + Ac^{\frac{1}{2}}$ is determined and found to agree, within 4 %, with the theoretical value of the constant as determined by Falkenhagen and Vernon. The constants of several empirical equations are also given. AUTHORS.

3387. Viscosity of Urea in Aqueous Solution. G. R. Hood. *Physics*, 4. *pp.* 211–214, *June*, 1933.—The relative viscosity of aqueous urea was measured at 18° C. and 25° C. over a range of concentration from 0·005 to 1·876 mol/liter. Fluidity-volume-concentration curves exhibit negative curvature, evidencing that urea behaves like an electrolyte in that it decreases the fluidity of water less than would be expected on the basis of additive fluidities. It behaves like a non-electrolyte in that it exhibits no stiffening effect; *i.e.*, the value of the Falkenhagen constant A is zero. A table is included, giving a comparison of the observed and calculated values of the Falkenhagen constant A for 11 electrolytes. AUTHOR.

3388. Structural Viscosity and Elasticity in Molten Sulphur. W. Ostwald and H. Malss. *Kolloid Zeits.* 63. *pp.* 305–310, *June*, 1933. —The meaning of the sharp maximum occurring in the viscosity-temperature curve for molten sulphur is discussed fully. Experiments are described which reveal a pronounced structural viscosity and elasticity in a thread of sulphur forced through a capillary. The sulphur evidently consists of a disperse system of a special kind, having properties between 120° C. and 180° C., which need further investigation. Similar effects are found with beeswax, and with a foam made with water and sodium stearate. J. P. A.

3389. Viscosity of Colloids. I. Sakurada. *Kolloid Zeits.* 63. *pp.* 311–315, *June*, 1933.—A survey of various formulæ which have been proposed for the viscosity of certain colloids in terms of concentrations, and a discussion of their relations to one another. J. P. A.

3390. Fluidities and Associations of Alcohols and Esters of High Molecular Weight. E. C. Bingham and R. A. Stephens. *Physics*, 4. *pp.* 206–207, *June*, 1933.—The specific volumes and fluidities of six isomeric hexadecyl alcohols and the corresponding hexadecyl acetates have been measured from 0 to 100° C. where practicable. The associations of these liquids have been calculated and shown to be extraordinarily low. This suggests the importance of further studies on the association of compounds of high molecular weight and low association. AUTHORS.

3391. Theory of Film Lubrication. A. M. Robb. *Roy. Soc., Proc.* 140. *pp.* 665–694, *June* 1, 1933.—The assumption that the length of the "brass" determines the length of the oil film which is under pressure in film lubrication leads to an unreal conception of the velocity conditions at the inlet end of the film; it leads to unjustifiable curves of pressure along the film, and it does not give results in agreement with experimental results. It is found that in the Reynolds fundamental equation, *viz.*, $dp/dx=6\lambda u\ (h-h_1)/h^3$, h_1 is a variable and a measure of the quantity of flow at any section. It is not, as is usually accepted, a constant denoting the height of the section of maximum pressure. The variable character of h_1 necessitates the introduction of the notions of side *inflow* and *outflow* of lubricant. These conceptions lead to the conclusion that, for any radial clearance, the coefficient of friction is dependent on eccentricity alone; this has been verified by Goodman. Satisfactory agreement between theoretical and experimental results relating to load-carrying capacity and attitude-eccentricity locus is obtained by the use of these conceptions. J. S. G. T.

3392. Simplest and Most Accurate Viscometer. L. Ubbelohde. *Inst. Petroleum Technologists, J.* 19. *pp.* 376–420, *May*, 1933.—An exhaustive discussion of the accuracy of the different types of viscometers in use. A new method of measuring the lower liquid level is described; all errors due to surface tension effects are thereby eliminated. A. S. C. L.

3393. Correction in Viscometry by the Capillary-Tube Method. E. C. Bingham and J. A. Geddes. *Physics*, 4. *pp.* 203–205, *June*, 1933. —The hydrostatic head correction as ordinarily made in viscosity measurements may be in error. This is made evident when this correction is determined at widely different pressures or with liquids of widely differing fluidities. It is concluded that this error is due to differences in the value of the coefficient m of the kinetic energy correction in different directions of flow. Such differences are due to departure of the capillary tube from a true cylinder which may have arisen in the manufacture of the capillary or of the viscometer. These differences in the value of m are so considerable that not only should the value of m for each viscometer be determined but a separate value should be determined for each direction of the flow through the capillary. Fortunately, this measurement is simple. AUTHORS.

3394. Automatic Timing of the Ostwald Viscometer by Means of a Photoelectric Cell. G. Jones and S. K. Talley. *Physics,* 4. *pp.* **215–224,** *June,* **1933.**—A new method for the automatic measurement of the time of flow of a liquid in a viscometer of the Ostwald type by means of a photoelectric cell is described. The elimination of the psychological errors inherent in the older technique permits greater precision. Other sources of error in the use of the Ostwald viscometer are analysed and the precautions necessary for precision viscometry are discussed. AUTHORS.

3395. Measurement of Viscosity of a Molten Metal by Means of an Oscillating Disc. V. H. Stott. *Phys. Soc., Proc.* 45. *pp.* 530–544, *July* 1, **1933.**—Experiments have been made on the viscosity of molten tin by the use of an oscillating disc. The theory of the method has been investigated, and it has been found necessary to calibrate the apparatus on molten metals having viscosities and densities not too different from those of the metals which are to be investigated. In the case of tin, the values of the viscosity at different temperatures have been determined by Sauerwald and Töpler by the capillary-tube method, and the present experiments have lengthened the range of temperature for which the viscosity of tin may be regarded as fairly well established. Discontinuity in the (viscosity, temperature) curve of molten tin at temperatures near its freezing point must be regarded as very improbable, and certainly does not occur at temperatures more than 6° C. above that point. It has been shown that the method of the oscillating disc may be used in cases where other methods of measurement are inapplicable, but it is desirable to verify the measurements which have been made by Sauerwald and his co-workers by the capillary-tube method in order that full reliance may be placed on the values of the viscosities of the metals which are most suitable for the calibration of the oscillating-disc type of apparatus. AUTHOR.

See also Abstracts 3309, 3327, 3374, 3435, 3771.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

3396. Impersonal Astrolabe. H. Chrétien. *Comptes Rendus,* 196. *pp.* 1286–1288, *May* 1, 1933.—There is a notable increase in precision when precautions are taken against a personal equation, hitherto undetected, as shown by Chandon's work on the prism astrolabe. This error and one due to a change in exact adjustment are eliminated by using a diasporameter which compensates the displacement for the star's zenith distance. The author has altered the disposition of the mirrors of his original (1914) diasporameter, so that they form a roof of 60° angle, and the mirror, turned to the telescope (which is horizontal and pointed 120° from the star's azimuth) is silvered in rectilinear transparent bands so as to equalise the brightness of the two images. Part of the light is directed along the axis of the telescope, the other suffers reflection, first from the mercury bath and then from a plain silvered mirror, again along the axis. These images are considerably diffracted horizontally, but the resolving power of the telescope is unimpaired in the vertical plane which is the essential thing. The actual diasporameter in use is described. A. S. D. M.

3397. Apparatus for Measuring the Absolute Personal Equation in Prism Astrolabe Observations. (Mrs.) E. Chandon, R. de Volontat, A. Gougenheim. *Comptes Rendus,* 196. *pp.* 1780–1782, *June* 12, 1933.—Personal equation gives a systematic error affecting the pendulum correction deduced from clock star transits, and may be considered equivalent to a slight retardation of the mean. The three authors discuss the forms of apparatus of Jobin-Yvon, Hurault (Chasselon) and Claude-Driencourt (S. O. M.) and tabulate the mean values of their personal equations. These show that the three forms of apparatus give satisfactory determinations of absolute personal equation in astrolabe observations and other instruments of equal altitude; they also show that visual apparatus is sufficiently good in time observations. [See preceding Abstract.] A. S. D. M.

3398. New Interference Micrometric Method Applicable to Double Stars and Satellites of Jupiter. A. Danjon. *Comptes Rendus,* 196. *pp.* 1720–1722, *June* 6, 1933.—The method is for comparatively faint objects; a diaphragm with single axial adjustable aperture is used; a diffraction pattern is set up by a Jamin's compensator or similar means; the author has examined the conditions for the disappearance of the central dark fringe. Tests have been made on double stars with good agreement with ephemerides; and on the satellites of Jupiter (diameters), giving: I, 0″·91; II, 0″·79; III, 1″·22; IV, 1″·10, all sensibly circular. T. L. M.

See also Abstracts 3421, 3445, 3532.

COMETS AND METEORS.

3399. Meteor Spectra. P. M. Millman. *Harvard Coll. Obs., Ann.* 82. *pp.* 113–146, 1932.—A brief review is given of the history of meteor spectrum observation from 1864 onwards. Nine spectra photographed at different observatories between 1897 and 1931 are reproduced and discussed. All are bright-line spectra, the number of lines varying from 6 to 53. A graphical plot shows their wave-lengths and intensities. All have been identified with elements common in meteorites, and are what would be expected from consideration of atomic physics and the average composition of meteorites. Iron is found in all the spectra, and other elements are Ca, Ca^+, Mg, Mn, Al, Cr, and indications of Si in two cases. The excitation potential of the upper level of the multiplets identified is under 6 volts in all the spectra. In general the multiplets of the iron spectra arising from the lowest level are abnormally strong. No general correlation exists between type of spectrum and colour of meteor, or shower to which it belonged. A definite amount of continuous spectrum is indicated, but this is probably due almost entirely to unresolved weak emission lines. M. A. E.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3400. Problem of Two Bodies with Variable Masses. W. Markowitz. *Astrophys. J.* 77. *pp.* 337–344, *June*, 1933.—This paper discusses the changes in the semi-major axis, *a*, and the period, *P*, of a binary picking up matter within a nebula. It is found that *a* varies inversely as the cube of the sum of the masses *M*, and, approximately, inversely as the square of the mass ratio μ. *P* varies inversely as M^5, and inversely as μ^3. It was found that Jupiter and the sun could not develop into a spectroscopic binary of large mass with mass ratio near unity. The two would fall into each other before this stage could be reached. What happens when mass is radiated depends upon the assumption made with regard to the process of radiation. For the case in which it is assumed that momentum is conserved when mass is radiated, it is found that if the mass ratio is constant, then *a* varies inversely as M^3 and *P* varies inversely as M^5: if it is not constant, then the problem is indeterminate. AUTHOR.

3401. Problem of Two Bodies with Decreasing Mass. E. Merlin. *Comptes Rendus*, 196. *pp.* 1718–1720, *June* 6, 1933.—The author discusses the variation of the elements for different types of osculating orbit. A geometrical interpretation is given, and related to the case demanded by most theories where mass decreases but its second time derivative is positive. T. L. M.

3402. Limitations of Values of Adiabatic Invariants and Problems of Variable Mass. D. Graffi. *Accad. Sci. Torino, Atti*, 68. 3. *pp.* 262–273, 1933.—A dynamical system of one degree of freedom, whose Hamiltonian depends upon a parameter, is considered, and an upper limit is obtained for the variation of the cyclic integrals of Sommerfeld. These results are then applied to the problem of two bodies of variable mass and a limitation is found for the variation of the eccentricity of the orbit. A. J. McC.

LATITUDE AND LONGITUDE.

See Abstracts 3447, 3450.

NEBULÆ.

3403. Star-Counts in the Dark Nebula in Taurus. H. v. Klüber. *Zeits. f. Astrophysik*, 6. *pp.* 259–271, *May* 11, 1933.—Comparison of star counts in two dark regions of this nebula with three comparison-fields gives

(for stars up to 14·4 m.) an absorption of about one magnitude for stars of 9·5 m, rising somewhat for stars up to 14·4 m. A method due to v.d. Pahlen gives a total absorption of about 2·5 m. in the dark regions.
G. C. McV.

3404. Spectral Displacement of Extra-Galactic Nebulæ. F. Zwicky. *Helv. Phys. Acta,* 6. 2. *pp.* 110–127, 1933.—The distances and general characteristics of extra-galactic nebulæ are given. The various methods of investigating them are described. A historical account is given of the displacement of the spectra of these nebulæ towards the red end and of the relationship between distance and spectral displacement. Reference is made to the various cosmological theories that have been proposed to account for this spectral displacement, and also to the author's own theory based on a possible direct influence of the matter present in world-space on the frequency of light traversing it. The way in which the spectral displacement in question may affect theories concerning the origin of cosmic radiation is also discussed. H. L. B.

See also Abstract 3411.

PLANETS.

3405. Increase of Planet's Mass by Cosmic Dust. Part II. F. Zagar. *Accad. Lincei, Atti,* 17. *pp.* 88–92, *Jan.* 8, 1933.—Shows that the conclusions arrived at in Part I [see Abstract 1785 (1933)] are not invalidated by considering both the preceding and following surfaces of the planet. E. E. F. d'A.

3406. Method of Predicting Occultations for a Given Place. W. M. Browne. *Astron. J. No.* 993. *pp.* 1–5, *May* 31, 1933.—The method is a partly geometrical one involving as much simplification of labour as possible by using auxiliary tables and other devices; and is intended for the prediction to within $\frac{1}{2}$ minute of time and 1° of position angle of large numbers of phenomena, so that one night's observations may give a complete lunar position. A numerical example is given in detail. T. L. M.

See also Abstracts 3366, 3398.

STARS.

3407. Absolute Magnitudes of 792 Stars of Spectra O to A5 Derived from Hydrogen Line Intensities. E. Öpik and Margaret Olmsted. *Harvard Coll. Obs. Circ.* 380 [19 *pp.*], 1932.—The authors find a correlation between absolute magnitude and total hydrogen line intensity for different spectral classes separate. There is a cosmic spread of the true absolute magnitudes, more or less uniform from − 4 to + 2, due partly to the use of binary and multiple systems treated as single stars, partly to a real spread around the main mass-luminosity, or surface gravity-luminosity-temperature relation. The absolute magnitude $\bar{E}$ is computed and the average E is got by a small correction $(-5 \log \bar{\rho}/\rho_0)$ for radial velocity (ρ): this holds rigorously for a uniform distribution of stars, and also for non-uniform distribution by weighting ρ by the number of stars within its limited area; corrections are made for absolute magnitude zero point and for parallax of clusters and the average effect produced by duplicity. The catalogue contains all stars for which the intensity of the hydrogen lines was estimated. [See Abstract 3200 (1932).] A. S. D. M.

3408. Star Streams in the Neighbourhood of 14^h R.A. and 54° Dec. A. Bemporad. *Accad. Lincei, Atti,* 17. *pp.* 601–605, *April* 23, 1933.—Eight plates of a region adjoining that which was discussed [see Abstract 2852 (1933)] are now analysed, and the results regarding star-streaming are confirmed and completed. Sixteen stars have annual proper motions greater than 0″·10. The distribution of the motions and the frequency curve of their magnitudes resemble closely those found for the first eight plates. M. A. E.

3409. Apparent Displacements of Polaris. J. Xanthakis. *Comptes Rendus,* 196. *pp.* 1649–1651, *May* 29, 1933.—The inferior and superior azimuths ($A_i - A_s$) deduced from meridian observations of Polaris show systematic differences examined by Esclangon [see Abstract 2421 (1929)] for the period 1883–1915. The author (with others) made similar measures with the transit circle of the Strasburg Observatory for the years 1930–1933, and have found that these do not lie on Esclangon's estimated curve for the lacuna, 1915–1930. The differences, $A_i - A_s$, show as a sinusoid having an axis inclined and a period of 21·5 years. J. H. Moore has found an orbital motion for Polaris from spectroscopic observations of 29·6 years, and therefore this displacement of the star is not sufficient to explain the course of $A_i - A_s$. Neither does the variation of latitude prove sufficient to explain the difference of the two periods, and the observations are not yet numerous enough to show the cause.
A. S. D. M.

3410. Absorption of Light in Interstellar Space. J. Dufay and Ssu-Pin Liau. *Comptes Rendus,* 196. *pp.* 1372–1374, *May* 8, 1933.—The authors utilise 55 bright stars of types O_6 to B_2 from W. Becker's precise measures of colour indices (C) so as to discriminate between effects due to diminishing temperature with increasing luminosity and those due to the differential absorption of blue over yellow rays by matter in interstellar space. (1) They establish that there is no statistical relation between C and absolute spectroscopic magnitude, the coefficient of correlation found being $R = +0{\cdot}156 \pm 0{\cdot}131$, this correlation tending to diminish when B_3 stars are included. There is an appreciable correlation, on the contrary, between C and r (distance in kiloparsecs), giving $R = +0{\cdot}456 \pm 0{\cdot}107$ for O_6 to B_2, and $R = +0{\cdot}431 \pm 0{\cdot}078$ for O_6 to B_3. (2) C increases with r for $O_6 - B_2$ giving the relation $C = -0{\cdot}255 + (0{\cdot}160 \pm 0{\cdot}20)\,r$, and this is not sensibly modified by the inclusion of B_3 stars. The absorption increases by 0·16 magnitude per kiloparsec between the radiation groups isolated by Becker's filters, and the difference of absorption coefficients corresponding to photographic and visual measures in $0{\cdot}36 \pm 0{\cdot}04$ magnitude per kiloparsec. (3) The increase of colour index and intensity (i) for the stationary rays of calcium are sufficiently linked with the above to make it probable that both can be attributed to a common absorbing medium. The relation is: $C = -0{\cdot}264 + (0{\cdot}0166 \pm 0{\cdot}0031)\,i$. A. S. D. M.

3411. Physical Analysis of Wolf-Rayet Spectra. Cecilia H. Payne. *Nat. Acad. Sci., Proc.* 19. *pp.* 492–494, *May,* 1933. *Zeits. f. Astrophysik,* 7. 1–21, *July* 24, 1933.—From Edlén's work [see Abstract 2349 (1932)] nearly all the Wolf-Rayet star lines have been identified; a list is given of the atoms for such lines; no "forbidden" lines have been recognised. The Wolf-Rayet stars fall into two categories as being with or without carbon; and the bright line-spectra of many stars may contain lines arising from 3 or more successive stages of ionisation of the same atom, and having a range in excitation of perhaps 100 volts for lines simultaneously present in some of the spectra. Their physical constitution exhibit three features: (1) their temperatures are inordinately higher than the B stars, the hottest being at minimum 100,000° [see Abstracts 377 and 3674 (1932)]; (2) the ionisation is not in a stellar atmosphere, but in a compact planetary nebula [see Abstract 2317 (1928)]; (3) there are real differences in atomic nuclei abundance (from no carbon to much carbon) and the absence of carbon lines is not due to physical suppression, for which examples and reasons are given. While the minimum temperatures of the exciting stars are known, it is possible to make a specific picture of the associated " nebula," and to relate it to the more tenuous nebulæ that surround planetary nuclei. The interpretation of Wolf-Rayet line profiles, in terms of continuous outflow of their atmospheres, fits well into this picture, as do the existence of hydrogen envelope stars and of those intermediate between bright-line B stars and planetary nebulæ. The author concludes that Wolf-Rayet stars represent a special case of the problem of the nebular spectrum.

A. S. D. M.

3412. Colour Indices and Integrated Magnitudes of Fifteen Bright Globular Clusters. A. N. Vyssotsky and Emma T. R. Williams. *Astrophys. J.* 77. *pp.* 301–309, *June*, 1933.—Extra-focal photographs of fifteen globular clusters were obtained in blue and in yellow light with two short-focus cameras. It is found that the lower the galactic latitude of a cluster, the redder is its colour. The increase in colour corresponds to a differential absorption of $0^{\mathrm{m}}\cdot 11 \pm \cdot 02$ encountered by light passing perpendicularly through the Milky Way. The derived integrated apparent magnitudes of the clusters lead to integrated absolute magnitudes which, on the average, are 2 mag. brighter than the integrated absolute magnitudes of Hubble's objects connected with M 31 which he has provisionally identified as globular clusters. AUTHORS.

3413. Spectrum of the B0 Star 23 τ Scorpii. O. Struve and T. Dunham, Jr. *Astrophys. J.* 77. *pp.* 321–329, *June*, 1933.—Wavelengths of 296 absorption lines in the spectrum of the B0 star τ Scorpii are given. Of these 243 have been identified with H, He I, He II, C II, C III, N II, N III, O II, O III, Mg II, Al III, Si III, Si IV, P III, S II, S III. The widths of helium lines which do not belong to the diffuse series and which are immune to electrical fields have been tested for termal Doppler broadening. He 3965 has a core 0·55 Å wide, in agreement with theory, which predicts that it should be between 0·4 and 1·0 Å. AUTHORS.

3414. Peculiar Branch of the Spectral Sequence in the Interval B8–F0. W. W. Morgan. *Astrophys. J.* 77. *pp.* 330–336, *June*, 1933.—The peculiar spectra (exclusive of the *c*-stars) in the range B8–F0 can be arranged in an apparent temperature sequence which may be discrete from the normal giants and dwarfs. Each group of peculiar spectra is related to the groups of next higher and lower effective excitation. In order of decreasing degree of ionisation the groups and type stars are: the " Mn II stars " (α Andromedæ and μ Leporis), stars in which the unidentified line at λ 4200 is well marked (θ Aurigæ), the Eu II stars (α^2 Canum Venaticorum at maximum of Eu II), the Cr II stars (73 Draconis), and the " Sr II stars " (γ Equulei). All of these groups overlap the contiguous ones. If the peculiar stars brighter than 5·5 mag. are arranged in these groups, it is found that the peculiar branch contains all the silicon stars. The variations in the spectrum of α^2 Canum Venaticorum can be interpreted in terms of such a peculiar sequence as being due to changes in effective excitation similar to those observed in Cepheids in the normal sequence. AUTHOR.

3415. Oscillations in the Photosphere of a Rotating Star. M. Kurihara. *Kyoto Coll. Sci., Mem.* 16. *pp.* 177–191, *March*, 1933. *In German.*—The possible types of wave motions in the photosphere of a rotating star are studied, and a numerical application made to the case of the sun. G. C. McV.

3416. Equilibrium of Distorted Polytropes. Part II. Tidal Problem. Part III. Double-Star Problem. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 93. *pp.* 449–471, *April*, 1933.—The equilibrium configuration of a spherical mass of gas which is disturbed by the tides due a second mass are worked out. The undisturbed configuration is supposed to be polytropic and the corresponding solution of Emden's equation known. The tidal effect of the second body is assumed to be the same as that of a mass point. To this degree of approximation, the problem can be solved by numerical solution of certain differential equations, tables of Emden functions being given. It is shown that a gas sphere, towards which a tidally disturbing body is slowly brought, gets distorted in shape in such a way that the volume and central density remain constant. The amounts of the distortions at the poles and the equator are also worked out. In the double-star problem, the distortions produced on an initially polytropic distribution of gas, by rotation as well as by tidal disturbance are worked out. To the order of approximation considered in Part I [see Abstract 2859 (1933)] and in Part II, it is shown that these two effects are simply additive. Neglecting fourth and higher powers of the ratio of the radius of the undistorted configuration to the distance between the component stars, the equilibrium configurations are ellipsoids. G. C. McV.

3417. Influence of Neutrons on the Internal Structure of the Stars. S. Flügge. *Zeits. f. Astrophysik*, 6. *pp.* 272–292, *May* 11, 1933. —It is shown that if a star contains neutrons, the transport of energy by conduction may be high owing to the long free paths of these particles. The percentage of neutrons is found which would give equality for the transfer of energy by radiation and by conduction. It is shown that for the distribution of density and temperature found in polytropic star models, this equality is attained with a proportion of 2–6 % of neutrons in the stellar material. The equations of equilibrium of a spherical aggregate of matter containing electrons, protons and neutrons, are therefore set up and it is deduced that, for molecular weight 2·2, the percentage of neutrons decreases inwards from the boundary of the model, then increases again. Numerical solutions of the equations for two models, one with neutrons, the other without, and of the same outer radius, total mass and luminosity, are given. The model with neutrons has a more rapid rise of gas-density but a slower initial rise of temperature, proceeding inwards from the boundary, than that without. Eventually, however, the temperature in the interior of the first model is rather greater than in that of the second. The bearing of the presence of neutrons on energy-generation is also discussed. G. C. McV.

3418. Pulsation Theory of Cepheid Variables. J. A. Edgar. *Roy. Astron. Soc., M.N.* 93. *pp.* 422–441, *April*, 1933.—The problems treated arise from the criticism of the pulsation theory that harmonics with one or more nodes in the interior of the star are possible as well as the (observed) fundamental vibration. The author first derives the equations for the pulsation theory in detail following Rosseland's method, assuming the oscillations adiabatic and the change of state due to them small enough to justify the derivation of the variational equations. Two numerical solutions are given for the fundamental and first harmonic modes. In the latter case a great increase in the displacement between the first and second nodes suggests that the harmonics will suffer much greater dissipation than the fundamental and not be observed. The actual dissipation of energy for the different cases is tabulated with the same general conclusion. The theoretical period for the first harmonic is calculated. On the assumption of free oscillation of the system, it is found that the fundamental will decay in about 8000 years, the first harmonic much more rapidly. While this may account for the non-appearance of overtones, another cause for maintaining the pulsation is probably required. The author finds this by separating the opacity part of the dissipation; by reducing the index of the opacity relation the free pulsations might be maintained indefinitely, the overtones probably remaining absent. The author also gives two demonstrations that the star is stable when vibrating under either the fundamental or first harmonic modes. T. L. M.

3419. Variable Star BD 41°. 1044. J. Hopman. *Zeits. f. Astrophysik*, 6. *pp.* 385–392, *June* 21, 1933.—The use of this star as a control in observations of Zeta Aurigæ led to the discovery that it is itself an interesting variable of the RR Lyræ type, with a period of only $2^h\ 22^m$. The colour index varies, indicating a change of spectrum from B0 to G2. M. A. E.

See also Abstracts 3339, 3398.

SUN.

3420. Polarisation of Solar Corona Studied Spectroscopically during Eclipse. J. Dufay and H. Grouiller. *Comptes Rendus*, 196. *pp.* 1574–1576, *May* 22, 1933.—Minnaërt's theory that the scattered light of the corona is due to scattering by free electrons was rendered doubtful by certain visual and photographic observations which seemed to prove that the proportion of polarised light in the corona varied considerably with wave-length. It was therefore important to make fresh observations, and this was done at Louisville, Quebec, at the eclipse of August, 1932, by members of the de la Baume-Pluvinel expedition. The sky was clear near the sun during the whole of totality. It was found that the proportion of polarised light over the whole spectral region photographed was almost entirely independent of wave-length, and thus the chief difficulty in Minnaërt's theory is eliminated. The proportion increases rapidly with distance from the sun's limb up to about 10′, then slowly decreases; and at equal distances on opposite limbs it is almost equal, even though there may be some difference in brightness. M. A. E.

3421. Photometry of Solar Eclipse Phenomena. C. H. Sharp, S. McK. Gray, W. F. Little and H. J. Eckweiler. *J.O.S.A.* 23. *pp.* 234–245, *July*, 1933.—The use of the term " brightness " with reference to the solar corona is criticised as misleading and not in accordance with photometric usage. The quantity to be measured is the illumination produced by the corona. Discussion is made of erroneous and misleading values for corona illumination which have been published and which refer to illumination produced not by the corona alone but by the corona together with a large area of sky and which have no especial scientific significance. Specially designed photometers are described for measuring the coronal light, the horizontal illumination and sky brightness. These have filters to give a colour match in the photometric field as closely as the colour to be encountered can be predicted. They have easily manipulated neutral screens to cover the range of intensities. The coronal photometer has an optical system whereby the field included is accurately defined and a "home-made" heliostat to keep the sun in position. There is also a photoelectric photometer for corona measurement consisting of a vacuum photoelectric cell with coloured filters correcting its response to the eye sensitivity curve. This acts through an amplifier with an FP-54 tube and is fitted with an optical system for deliminating the field. Special recording arrangements are described. Cloudiness prevented any measurement of the corona light during the eclipse of August, 1932. It was found that the total illumination on a horizontal plane at the time of totality was 0·35 foot-candle. AUTHORS.

3422. Registrations with Ångström's Pyranometer. Parts I and II. E. Hasché. *Gerlands Beitr. z. Geophys.* 38. 1. *pp.* 19–46, *and* 39. 1. *pp.* 12–36, 1933.—The author refers first to the importance of infrared radiation measurements for many physical, meteorological, biological and medicinal investigations. The Ångström pyranometer is of great practical usefulness for these purposes and information is given for an easier handling and thus greater practical use of the instrument. The method of registration, sources of error and their correction, with examples of each, are fully treated and a useful method for classification of the registrations for practical purposes is given which yet retains physical accuracy. The use of the instrument in determining the cloud form in the sky, and its amount and depth, is discussed from examples of different records and it is shown that the passage of discontinuities can be traced in this way. Turbidity in the atmosphere due to dust or water vapour is examined. The uses and limitations of the instrument in heliotherapy are enumerated and explained, and also its use to identify short and long period oscillations in solar radiation. The discussion is based on observations made at Danzig. R. S. R.

3423. Influence of Solar Activity on the Earth's Atmosphere. B. Düll. *Gerlands Beitr. z. Geophys.* 39. 1. *pp.* 1–9, 1933.—The author considers that certain statistical methods formerly in use to determine the correlation between solar activity and variations in the state of the earth's atmosphere are unsatisfactory because the solar influence may depend upon a special state of the atmosphere and be only temporary. Relations found between weather and anomalies of radio reception and spark measurement are only apparent as they are seldom observed during the day and are active only during twilight or at night when the waves penetrate the Kennelly-Heaviside layer and reach the receivers. He considers large changes in this layer are due to a sudden electro invasion by α-particles, electrons and photoelectrically excited metal and dust molecules into the earth's atmosphere, which are characterised by a sudden strong increase of the earth's magnetic disturbances. Many observations indicate that electrically charged particles derived from the sun, under favourable circumstances depending on the general circulation of the atmosphere, can serve as nuclei of condensation. The author describes two methods of using a series of observations extending over six months which are divided into 27-day groups, and each individual daily observation is employed. Various figures illustrate the practical use of these methods. R. S. R.

3424. Simple Spectrograph and Infra-Red Absorption Bands of the Solar Spectrum. W. Gorczyński. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3 *A. pp.* 40–52, *Jan.–March,* 1933. *In English.*—The author describes a simple infra-red spectrograph employing a flint prism and a linear thermopile or a thermoelement *in vacuo*, and carried by an equatorial mounting. The thermopile is connected to a mirror galvanometer which is used in conjunction with a photographic recording apparatus. The flint of the spectrograph is rotated by clockwork so that a complete record of the distribution of energy in the solar infra-red is obtainable in a few minutes. Observations with this apparatus made in North Africa in 1926/27 are described. The principal interest was the atmospheric transmission in the water vapour absorption bands ρ ($0\cdot93\mu$) and Φ ($1\cdot13\mu$) and concurrent measurements of the humidity were made using an aspiration thermometer. In all 331 infra-red spectrograms were obtained. The results are discussed in a later paper. [See following Abstract.] W. S. S.

3425. Atmospheric Transmission in the Water-Vapour Absorption Bands ρ and Φ. W. Gorczyński and E. Stenz. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3 *A. pp.* 53–64, *Jan.–March,* 1933. *In English.*—The spectrograms of the solar infra-red obtained by the method and conditions described in a previous paper [see preceding Abstract] are here analysed and discussed. The spectrograms were obtained at different times of the day and the data are therefore divided into groups corresponding to different lengths of the solar ray paths in the atmosphere. For each group, the transmission in the water vapour bands ρ and Φ is derived as a monthly average, and compared with the mean water vapour pressure determined psychrometrically at ground level. The transmissions show general correlation with the observed water vapour pressures. The relation between the transmissions in the water vapour bands and the amount of precipitable water found by Fowle from laboratory measurements is used to study the connection between precipitable water and vapour pressure, in the present data. [See following Abstract.] W. S. S.

3426. Water Vapour Absorption in the Infra-Red Region of the Solar Spectrum. E. Stenz. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3 *A. pp.* 65–76, *Jan.–March,* 1933. *In English.*—This paper gives spectrographic data for the atmospheric absorption in the water vapour bands Φ and ρ, obtained at Montpellier and Nice over a period of eight months. The ratio of the precipitable water derived from the spectrograms [see preceding Abstract] to the directly observed vapour pressure was found to vary during the year and the conclusion is drawn that the atmospheric layers over the Mediterranean coast contain during the colder months, less water vapour than psychrometric data at the earth's surface seem to indicate. The use of the spectrographic method for estimating the water vapour contents of the atmosphere is strongly recommended at stations where the sunshine duration is large enough. W. S. S.

See also Abstracts **3339, 3366, 3415, 3449.**

GEOPHYSICS.

GEODESY.

See Abstract 3432.

GEOPHYSICS, APPLIED.

3427. Seismic Reflection Method of Prospecting. C. A. Heiland. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. 3. *pp.* 282–336, 1933.—The author reviews in considerable detail the reflection method of seismic prospecting. Its advantages compared with other geophysical methods, and comparative cost and results attainable are discussed. The special problems involved and the history of the technique and apparatus evolved to meet them are considered. After a summary of the special requirements needed in the apparatus, an account is given of an electro-magnetic seismograph amplifier with dual filter and oscillograph recorder which have been constructed for this work under the author's direction at the Colorado School of Mines. Details are given of tests made with this apparatus in the field, and some records are reproduced, showing the onset of the reflected wave. The probable accuracy of depth determination of the reflecting layer is estimated to be of the order of 2 m. in a depth of 1000 m. The article concludes with a brief review of the possible application of the method in the North German plain, and a full Bibliography of references to previous literature and patents. E. L. J.

HYDROSPHERE, PHYSICS OF THE.

3428. Theory of the Rising Stage of Drift Current in the Ocean. Part I. Case of No Bottom-Current. T. Nomitsu. *Kyoto Coll. Sci., Mem.* 16. *pp.* 161–175, *March,* 1933. *In English.*—Fjeldstadt's solution of the rising stage of drift current in a sea of finite depth is too laborious and inconvenient for practical use. The author solves the same problem for constant and varying wind in an exceedingly easy way which is very rich in physical meaning and very convenient for numerical calculation. He exemplifies this for several ocean depths. He finds that when a constant wind begins to blow over a boundless sea the current produced may be taken to reach a steady state in time as shown below :

Depth of sea	D/10	D/4	D/2	D	2D
Time in pendulum hours	1	6	18	48	120

where D is the so-called " frictional depth." A formula is obtained for the decay of the steady current when the wind suddenly stops and it is shown that the subtraction of this decaying current from Ekman's steady value furnishes the developing stage of the current required. R. S. R.

3429. Development of Slope Current and Barometric Current in the Ocean. Part I. Case of No Bottom-Current. T. Nomitsu. *Kyoto Coll. Sci., Mem.* 16. *pp.* 203–214, *May,* 1933. *In English.*—When a surface slope exists in a sea, owing to causes such as wind action or the supply of tributary water from the land, there will be produced a current called the " slope current." Ekman dealt with the case of a constant and uniform slope. The author deals first with the development of a slope current theoretically and shows that, (1) the current will oscillate asymptotically around a steady value with a period of 12 pendulum hours, (2) the

time required for it to become steady is substantially equal to that for the drift current, (3) if the depth of the sea exceeds 2D, the development of the current in the first few days is almost the same as that in an infinitely deep sea and although it will take several days to reach the steady state completely, the daily mean will be nearly the same as the final value for the first day, and (4) the shallower the sea, the weaker is the current. The barometric current produced by a local difference in atmospheric pressure is next discussed and it is emphasised that this may be as important as the drift current, the slope current or the convection current especially when considered with respect to the circulation in deep layers of the ocean. Thus for a sea of depth > 2D at latitude 35°, a uniform gradient of pressure of 1 mm./km. produces a current whose surface velocity in the steady state is 3·02 knots. Practical investigation of the results is to be made from liners.
R. S. R.

3430. Tides on a Rotating Globe. Part IV. G. R. Goldsborough. *Roy. Soc., Proc.* 140. *pp.* 241–253, *May* 3, 1933.—In previous papers of this series approximate solutions of the tidal equations have been given which represent the semidiurnal tide in an ocean bounded by two meridians of longitude 60° apart, similar to conditions in the Atlantic Ocean [see Abstract 1767 (1930)]. In this paper the normal modes of free tidal oscillation of an ocean of uniform depth bounded by two meridians are investigated. Solutions of the general dynamic equations of the tides are assumed in the form of doubly infinite series of spherical harmonics with undetermined coefficients. The relations between these coefficients are deduced as linear simultaneous algebraic equations. These equations can be solved to a first approximation without much difficulty, and in one case have been solved to a second degree of approximation. The principal conclusion is that in an ocean of uniform depth, 12880 ft. and bounded by two meridians of longitude, 60 ° apart, there is a normal mode of vibration having a period of 12 hours 33 minutes of mean solar time. It is shown that the normal frequencies appear in groups of three giving a wave travelling in (1) a positive direction, and (2) a negative direction, both of which remain finite as the speed of rotation diminishes, and (3) an oscillation of the " second class " corresponding to a wave travelling in the positive direction and reducing to a steady motion as the speed of rotation diminishes. Under certain conditions the methods used can be extended to any width of ocean, such as the Pacific with two meridians 120° apart. R. S. R.

LAND, PHYSICS OF THE.

3431. Variation in the Effective Rigidity of the Earth. H. Nagaoka. *Imp. Akad. Tokyo, Proc.* 9. *pp.* 166–169, *April*, 1933. *In English.*—By making certain assumptions the variation in the mean rigidity of the earth is calculated, and it is shown not to be constant. The rigidity seems to be increased or diminished by subterranean disturbances, leading to catastrophic eruptions or earthquakes. The rigidity may remain constant under undisturbed areas, such as northern Europe, but vary in those regions where subterranean disturbance takes place, *e.g.*, the Pacific. W. A. R.

3432. Thermal History of the Earth. A. Holmes. *Washington Acad. Sci., J.* 23. *pp.* 169–195, *April* 15, 1933.—The paper comprises a critical survey of the whole field for four different hypotheses advanced by various authors to explain the thermal history of the earth. The physical

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assumptions involved in each are reviewed and their geological consequences compared with what is known of the realities of the earth's history. The radio-thermal energy of the rocks and its distribution in the different layers are examined and next the relations of the convection and freezing point gradients are discussed. Two forms of the thermal contraction hypothesis are examined in both of which the sub-crustal layer is negligibly radioactive but in one form (1) the freezing point gradient is steeper than the convection gradient throughout, while in the other, (2) the gradients are tangential at an intermediate depth. The former fails to explain why the igneous activity of the earth is not increasing while the other leads to even less probable results. In the hypothesis of thermal cycles the substratum is considered to be slightly radioactive and the gradients as at (1) above, but this theory is not considered able to account for the development of geosynclines and the long mountain ranges. Finally, in the subcrustal convection current hypothesis the gradient in the convection layer is considered to be tangential to the freezing point gradient at some intermediate depth. The advantages of this last hypothesis are explained as more consistent with a wide range of geological and geophysical data. It requires the local operation of thermal cycles within the crust and it necessarily involves contraction in regions where crustal cooling occurs. It is also sufficiently complex to match the astonishing complexities of geological history.

R. S. R.

3433. Measurement and Interpretation of Deep Earth Temperatures. C. E. van Orstrand. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. 3. *pp.* 261–281, 1933. *In English.*—A brief description is given of the apparatus used by the U.S. Geological Survey and the American Petroleum Institute in conducting recent geothermal surveys. As a result of tests in 700 wells located chiefly in producing oil fields, instances have been found in which the isogeothermal surfaces rise in passing over salt domes, faults, sand lenses, and structures of large and small closure.

AUTHOR.

3434. Radio Properties of the Soil. R. L. Smith-Rose. *Roy. Soc., Proc.* 140. *pp.* 359–377, *May* 3, 1933.—The application of a laboratory method for measuring the conductivity and dielectric constant of samples of soil taken from selected sites at the National Physical Laboratory, Teddington, is described. These measurements were made over a range of frequencies of from 1000 ~ to 10 million ~, and for various moisture contents ranging from practically zero up to a value exceeding that normally experienced for surface soil taken direct from the ground. The results of these measurements show that the conductivity varies from less than 10^5 e.s.u. for dry soil, up to a value of approximately 10^8 e.s.u. for normal moisture content. Corresponding values for the dielectric constant range from 2 or 3 for dry soil up to about 20 for moist soil at high radio frequencies. The results of measurements made on a number of samples of soil taken at random from several other sites are included in the paper, and show that both the normal moisture content and the conductivity can have values which are appreciably higher than those experienced at Teddington. The paper concludes with a brief discussion of the penetration of radio-frequency currents in the earth, and the effective depth of penetration has been calculated in some instances with the aid of the experimental values of conductivity and dielectric constant determined above.

E. E. F. d'A.

3435. Permeability of Porous Media for Homogeneous Fluids. R. D. Wyckoff, H. G. Botset, M. Muskat and D. W. Reed. *Rev. Sci. Instruments,* 4. *pp.* 394–405, *July,* 1933.—A detailed technique is described for the measurement of the permeability of porous media, by the use of either liquids or gases. Derivations are given of the formulæ by which the permeability may be computed from the laboratory measurements. In addition to defining a convenient permeability unit, it is proposed to call it the "darcy." Field measurements on the effective permeability of underground sands are discussed, and the appropriate formulæ are derived. These include expressions for liquid flow, gas flow, gravity flow and composite artesian and gravity flow. Correction curves are given for application when the wells do not completely penetrate the producing sands. AUTHORS.

See also Abstract 3447.

METEOROLOGY.

3436. Vertical Distribution of the Temperature of the Air in the First Two Metres above the Ground. P. Seltzer. *Comptes Rendus,* 196. *pp.* 1626–1628, *May* 22, 1933.—This note deals mainly with the inversions of temperature which occur near the ground under different meteorological conditions. The times of day chiefly considered are those near sunrise and sunset, the effects, those of cloud and wind. The influence of herbage is also investigated. The results are illustrated by diagrams. With regard to the method used, the author states that a description of this will be given later elsewhere. A. E. M. G.

3437. Direction and Velocity of Wind in the Vicinity of a Wind Tower. H. Arakawa. *Geophys. Mag.* 7. *pp.* 19–23, *April,* 1933. *In English.*—The problem of the effect of an isolated tower in flat country on the velocity and direction of the wind is discussed. Curves show the velocity and frequency of winds from different directions, at infinity, and at the top of the tower. It is found that on account of the boundary effect of the tower the velocity of the wind increases considerably in the plane of the tower especially near the top and the frequency in this direction becomes large compared with that in the original direction. The tendency depends inversely on the ratio, width/height, of the tower. To avoid such irregularities the wind tower should be of hemispherical shape. The wind velocity increases even then near the obstacle, but the direction of the wind in the free atmosphere can be obtained since this is unaffected by such an obstacle in a uniform flow by a semi-infinite plane. R. S. R.

3438. Diurnal Barometric Oscillation as an Effect of a Surface Wave and a New Method to Determine the Diffusivity of Air in Free Atmosphere. H. Arakawa. *Geophys. Mag.* 7. *pp.* 25–29, *April,* 1933. *In English.*—A theory has been developed for the diurnal oscillation of atmospheric pressure which shows that it is caused by a surface wave due to temperature variations and, following Margules, the pressure oscillation is discussed when a temperature wave exists. It is shown that the amplitude of the pressure oscillation due to temperature variation diminishes exponentially with altitude, the rate depending on the diffusivity. Since this rate of decrease with altitude is very great the main part of the pressure oscillation is a surface wave. From an analysis of the observations at the summit and foot of Mt. Tukuba over the period 1930–1 the variation of amplitude of the diurnal pressure oscillation with altitude becomes

$e^{-0.000015z}$ and the diffusivity of air $1 \cdot 3 \times 10^5$ C.G.S. units, where z is the altitude. This method of determining the diffusivity of air in the free atmosphere by observations of atmospheric pressure is useful and reliable, and easier to employ than wind-speed or air-temperature observations.

R. S. R.

3439. Harmonic Analysis of the Atmospheric Pressure Oscillation in Europe in the Winter 1925–1926. L. Steiner. *Gerlands Beitr. z. Geophys.* 39. 1. *pp.* 82–99, 1933.—The author refers to the results obtained by Mildner, Weickmann, Lehmann and Haurwitz for pressure oscillations during the two previous winters of which the first was rather cold, and the second extraordinarily mild while 1925–6 was nearly normal except for a very mild February. In the investigation 267 stations are used and for a period of 72 consecutive days the first twelve coefficients of the Fourier series have been calculated. Twelve periods are discussed, 72, 36, 24, 18, 14·4, 12, 10·29, 9, 8, 7·2, 6·55 and 6 days, and for these the respective positions of maximum and minimum amplitude and the variations of phase angle are described. The results are also compared with those for the two previous winters. R. S. R.

3440. Development in a Pressure System. G. Dedebant. *Comptes Rendus,* 196. *pp.* 1736–1738, *June* 6, 1933.—This note is an extension of previous work on the barometric field [see Abstract 3610 (1932)]. Two main fields contribute to the establishment of the total field of pressure, a fixed and a variable ; the author considers the behaviour of the latter under two heads, (*a*) a movement as a whole and (*b*) a development, either increase or decrease, within the disturbance. A mathematical method of separating the various effects is indicated, and thereafter section (*b*) *i.e.*, the development in a disturbance, is considered in more detail and an expression showing its connection with tendency, etc., derived. From this expression it follows that the barometric tendency represents this development in the particular cases where the isobars are tangential to the direction of motion, and likewise where there is no displacement of the disturbance. A. E. M. G.

3441. Beaufort Scale in Simple Formulæ and Rules for Memorising. O. V. Johansson. *Soc. Scien. Fennica,* 6. 24. *pp.* 1–26, 1932–1933. *In German.*—The author examines in detail the equivalent values of the Beaufort wind scale in use in different countries, the formulæ proposed to determine the scales and their relations with each other. Tabulated values of the constants, differences, and velocities are given for (1) the international scale (Linke), (2) the English-American scale based on Shaw's formulæ, (3) Köppen's original scales for the German, Norwegian and English coasts and the mean of these, (4) Köppen's smoothed scale and the scales for heights of 1·5 and 11·5 m., and (5) Simpson's scales for 1906, and for the mean of five stations and his smoothed and corrected Köppen's scale. The relations were further extended to a number of still older scales and their corresponding constants and validity discussed. Differences in the scales arise from the observations being made on land, at sea and on the coast, at different heights and with different kinds of anemometers and almost insoluble differences occur. Rules are given of a scheme by which accurate values may be obtained. Finally, a 10-step scale in km./hr. is proposed. This is compared with existing scales and its advantages discussed. R. S. R.

3442. Clouds in the Stratosphere. C. Störmer. *Comptes Rendus,* 196. *pp.* 1824–1825, *June* 12, 1933.—The results of observations on clouds in the stratosphere during 1932 by Norwegian observers are described. Two types are referred to, (*a*) clouds hitherto observed almost exclusively in summer, and on this occasion seen in July at a height of about 82 km., luminous nocturnal clouds, and (*b*) those observed in winter time (in this instance in January and February), at between 20 and 30 km., termed mother-of-pearl clouds. From coronæ observed in the latter the diameters of the particles of the cloud are found not to exceed 0·0025 mm.

A. E. M. G.

3443. Transparency of the Lower Atmosphere. H. Buisson, C. Jausseran and P. Rouard. *Rev. d'Optique,* 12. *pp.* 70–80, *Feb.,* 1933. —Tests were made at night with an artificial source of light to avoid errors due to scattering. Photographs were obtained at two stations. at different distances, using identical apparatus, employing a Hg arc in quartz as the source for the visible spectral range, and spark discharge from Cd, Zn, or Al for lower wave-lengths. The blackening of the plates is measured by means of a microphotometer. Compensating screens of different optical densities are used to get greater approach to equality and the spectra are compared over the whole range. A table gives the results of the tests for wave-lengths 5780 to 1855 Å. It is shown that the transparency is almost perfect in the visible range, but it begins to decrease at the commencement of the ultra-violet near 3000 Å, and more rapidly towards 2600 Å, until at 1855 Å the intensity is reduced to one-third after traversing 1 m. of air. The first part of the absorption can be attributed to a fraction of ozone, whose thickness 0·0022 cm., agrees with the results of chemical analysis, but subsequently it is due to oxygen as shown by the absorption bands of this gas.

R. S. R.

3444. Measurement of the Coefficients of Atmospheric Absorption. J. Duclaux. *Comptes Rendus,* 196. *pp.* 1524–1526, *May* 15, 1933.—Further observations were made under cloudless skies at Pic du Midi during the winter 1931–2, using the same method as before [see Abstract 3602 (1932)]. Objects viewed were fields of snow or rock ridges. For ultra-violet light in the range 3570–3800 Å a mean coefficient of absorption, k, for various distances, was found of $3{\cdot}84 \times 10^{-7}$. At normal air density k becomes $5{\cdot}43 \times 10^{-7}$. The Rayleigh-Cabannes formula gives $k = 6{\cdot}40 \times 10^{-7}$. For yellow light observation gives $k = 1{\cdot}25 \times 10^{-7}$ and theory gives $k = 0{\cdot}99 \times 10^{-7}$. The observed value is thus less than the theoretical for ultra-violet, but greater for yellow light. Stated in terms of wave-length (λ), k is proportional to $\lambda^{-3{\cdot}25}$ for observed values, but theory gives a value $\lambda^{-4{\cdot}11}$.

R. S. R.

3445. Photometric Observations of Twilight. W. M. Smart. *Roy. Astron. Soc., M.N.* 93. *pp.* 441–443, *April,* 1933.—The intensity of twilight per square minute of arc at the zenith (Cambridge) is measured for sun from 5° to 11° below the horizon. The graph of star-magnitude of twilight against depression of sun's centre is sensibly linear. The measures were made with the new photoelectric photometer of Cambridge Observatory; some account of the instrument and reductions is given.

T. L. M.

3446. Spectrum of Night Sky. J. Dufay. *J. de Physique et le Radium,* 4. *pp.* 221–235, *May,* 1933.—The spectrographs used, giving spectra of lengths 3·49 and 7·43 mm. between 5752 and 4044 are described.

With these observations towards south and west were made at the Lyons Observatory, mostly between September, 1931, and May, 1932, pointing 10–20° above the horizon. Results show a complex emission spectrum of varying intensity, being practically invisible on many nights. This spectrum is similar to that of the aurora, but the nitrogen bands are more feeble and there are many bands and lines of unknown origin, due perhaps to atoms of nitrogen or oxygen produced by excitation of the atmosphere at a height above that of the rays and draperies of the aurora. The lines 5893 and 6425 (the red auroral line) were observed. [See Abstracts 3193, 3754 (1932) and 970 (1933).] C. A. S.

See also Abstracts 3423, 3424, 3425, 3426, 3453, 3679.

SEISMOLOGY.

3447. Volcanic Eruptions, Earthquakes and Pole-Shift. H. Nagaoka. *Imp. Akad. Tokyo, Proc.* 9. *pp.* 170–173, *April,* 1933. *In English.*—The great eruption of Kilauea in May, 1924, took place just when the pole reached the meridian of Hawaii. Two years afterwards Mauna Loa was in a very active state of eruption, when the pole reached the apex and was again in the meridian of Hawaii. After the great Kwanto earthquake, the pole-shift gradually turned to the meridian of Hawaii. It appears that this earthquake gave an initial impulse to the accumulation and subsequent subterranean disturbance about the Pacific margin. [See Abstract 2889 (1933).] W. A. R.

3448. 42-Minute Period in Frequency of After-Shocks. C. Davison. *Seismological Soc. of America, Bull.* 23. *pp.* 57–79, *April,* 1933.—Examination of the records of after-shocks of 25 important earthquakes that occurred during the past 65 years supports the 42-minute period, and divides the earthquakes into three classes: In 10 (Class 1) the main after-shocks occurred at first at 42 *n* minute intervals after the main shock, in 11 (Class 2), including some of the greatest earthquakes, at 21 + 42 *n* min. intervals, and in 4 (Class 3) no regularity was found. In almost every case a reversal of period occurred after an interval varying from 6 hours to 14 days, followed sometimes by one or more further reversals. This throbbing of the earth continued for from 15 days to 3–4 months. In the Tango earthquake a 42-minute period was detected in the mean depth of focus. In Class 1 the initial movement was probably one of subsidence, in Class 2 of upheaval. Reversal seems due to change in direction of tilt of crust blocks. [See Abstract 1772 (1930).] C. A. S.

3449. Eleven-Year Period of Earthquake Frequency. C. Davison. *Phil. Mag.* 15. *pp.* 1085–1088, *June,* 1933.—The epochs of the eleven-year seismic period are the same in both hemispheres, and they agree closely with the corresponding periods of sunspot frequency.
W. A. R.

3450. Nineteen-Year Period of Earthquake Frequency. C. Davison. *Phil. Mag.* 15. *pp.* 1092–1095, *June,* 1933.—The seismic 19-year period seems to be closely connected with the nutation period of the earth. The two periods have the same duration, namely, 18·6 years. Their maximum epochs are nearly or quite coincident. W. A. R.

3451. Travel Time of Earthquakes. Parts I and II. K. Wadati, K. Sagisaka and K. Masuda. *Geophys. Mag. Tokyo,* 7. *pp.* 87–111, *April,* 1933. *In English.*—In Part I of the paper tables are given of the travel time of near earthquakes having foci of various depths, the calculations being based upon observed data of the North Idu earthquake. Honda, using the Helglotz-Wiechert method, found the velocity of seismic waves to a depth of 300 km. The authors have extrapolated to 500 km. using Honda's results and those of others on distant and deep-focus earthquakes. The table given, strictly, is applicable only for this part of Japan, but the errors in applying it elsewhere are negligible. It is assumed that there is no special discontinuity layer in the crust. The tables are of value in determining accurately the depth of focus, whether the epicentre is known or not. In Part II the arrival times of the P and S waves are investigated and applied to get the position of the epicentre and the focal depth. It is concluded that the velocity ratio of these two waves is approximately constant except for a thin surface layer of the earth's crust. This ratio appears to be closely connected with the Mohorovičić discontinuity. In the upper part of this surface the velocity ratio is about 1·72, while in the lower part and to a depth of several hundred km. it is nearly constant at 1·79. R. S. R.

3452. Accuracy of Seismographical Measurements for Non-Stationary Processes. H. W. Koch and W. Zeller. *Zeits. f. techn. Physik*, 14. 4. *pp*. 162–165, 1933.—The errors produced by damping and phase displacement in seismographs are, in the case of non-stationary processes, added to those due to the inswinging process of the instrument. For an allowable error the measurement frequency of a seismograph has a lower limit. Whilst an upper limit does not exist for measurements of stationary oscillations, this is not the case for non-stationary oscillations in consequence of the inswinging processes. In practice these two frequency requirements have to be set one against the other. Errors are calculated for values of the relative frequencies and of the damping factor. The most favourable damping occurs always for $a = 0{\cdot}77$. The suitability of the Askania oscillation measurer and of Spindler and Hoyer's seismograph for the measurement of the return oscillation is described from this point of view. [See also Abstract 1716 (1933).] R. S. R.

See also Abstract **3427**.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3453. Aerial-Earth Current. Part I. H. Noto. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 135–147, *March*, 1933. *In English.*—The aerial-earth current was recorded continuously over a period of 12 months by connecting the aerial through the recording apparatus to earth. There were large changes of both signs for severe thunderstorms, fluctuating changes but of one sign during rain, except with severe and prolonged rain, when changes of sign occurred, while showers give effects similar to thunderstorms. A statistical relation was made between aerial-earth current changes and meteorological elements. They were abundant when (1) the air temperature was near 0° C., near the average or very high, (2) cloud amounts were large, (3) air pressure very high or very low, and (4) when raining, and rather numerous for large relative humidity. For different cloud forms the frequency decreases in the order CuNb, Nb, ACu, CiCu, StCu, St, Cu, CiSt, ASt, Ci. In some measure electric disturbance and the occurrence of earthquakes are related. R. S. R.

3454. Influence of Condensation Nuclei and Dust Particles on Atmospheric Ionisation. P. J. Nolan. *Roy. Irish Acad., Proc.* 41. *pp.* 61–69, *May*, 1933.—Reference is made to Wright's results [see Abstract 1391 (1933)], from which it follows that combination of small ions with gross particles plays an important part in the ionisation balance. This is not in accordance with conclusions of Nolan and Brolchain, and their experimental results are re-examined. It is shown that the results exhibit a fair amount of conformity with the above deduction made by Wright. Assuming an equilibrium formula $q = (a\mathrm{P} + b\mathrm{Z})n$, the combination coefficients, a and b, of small ions with dust particles and with condensation nuclei are deduced from the experiments with a closed vessel, the ratio a/b obtained by Wright being assumed. It is shown that, when the concentration is low, the rate of disappearance of nuclei in a closed vessel is proportional to the concentration. On the basis of these results a hypothesis is proposed to account for the empirical equilibrium formula $q = \zeta n\sqrt{\mathrm{Z}}$. The equilibrium of ionisation in country air at Glencree is examined with unsatisfactory results.
R. S. R.

3455. Electrical Conductivity of the Air by a Nul Method. (Miss) O. Thellier. *Comptes Rendus*, 196. *pp.* 1684–1686, *May* 29, 1933. —In this note the author shows how she has devised a modification of Gerdien's method for the determination of λ, the conductivity of the air. A description and a diagram of the apparatus used are given, and also the method whereby Q and $d\mathrm{Q}^1/dt$ in the expression $\lambda = -(1/4\pi\mathrm{Q})\cdot d\mathrm{Q}^1/dt$ may be found with its aid, is indicated. In a table are set out some results of λ_+ and λ_- obtained during May. A. E. M. G.

3456. Time of Establishment of Lightning. H. Jehle. *Zeits. f. Physik*, 82. 11–12. *pp.* 785–793, *May* 30, 1933.—The growth of a flash of lightning is discussed and its time of establishment (*Vorwachsgeschwindigkeit*, forward rate of growth) is calculated (1) by determining the velocity of the electrons and the positive ions at an appropriate point, (2) from electrostatic considerations. Two simple continuity relationships are then deduced for the progress of the growth of the flash, which make it possible to deduce the current and charge distribution in the flash and which lead to an explanation of globular lightning. H. L. B.

3457. Theory of Earth Currents. D. Stenquist. *Gerlands Beitr. z. Geophys.* 39. 1. *pp.* 100–104, 1933.—The author refers to charts of the daily variation of the earth current which indicate an anticlockwise flow in middle latitudes commencing about midday. These are compared with charts of the earth's magnetisation and the rotation for each has the same axis and direction. It is shown that the magnetic changes on quiet days are due to variations in the Kennelly-Heaviside layer, but on days of magnetic storms the earth current is the more important. In both cases however Ampère's rule is valid and the N pole of the magnetic needle is deflected to the right of a person swimming in the direction of the earth current with face upwards. R. S. R.

See also Abstracts 3423, 3843.

RADIOACTIVITY.

3458. Theory of the Nucleus. G. Wataghin. *Accad. Lincei, Atti,* 17. *pp.* 645–647, *April* 23, 1933.—The theory of Heisenberg [see Abstract 4383 (1932)] is extended to include phenomena associated with the positive electron. F. C. C.

3459. Wave Mechanics Derivation of the Rutherford Formula. T. Sexl. *Zeits. f. Physik,* 82. 9–10. *pp.* 650–659, *May* 23, 1933.—As far as possible, a complete derivation of Rutherford's scattering formula in parabolic coordinates is given. J. J. S.

3460. Radioactivity of Samarium. G. v. Hevesy, M. Pahl and R. Hosemann. *Zeits. f. Physik,* 83. 1–2. *pp.* 43–54, *June* 6, 1933.—Investigations with a Geiger counter show that Sm emits α-particles having a range of $1 \cdot 13$ cm. in air at 15° C. and 1 atmosphere, corresponding to a velocity of $1 \cdot 05 \times 10^9$ cm.sec^{-1}. The number of α-particles emitted per sec. by 1 gm. of Sm is 75, the half-period calculated from this value being $1 \cdot 2 \times 10^{12} y$. By using the Geiger-Nuttal-Gamow relationship the half-period is found to lie between 10^{12} and $10^{14} y$. From the agreement between the half-period values calculated by the two methods, it is concluded that the activity of Sm cannot be due to small traces of an active isotope. The remaining rare earths (except Tm) were also investigated. In all cases the radioactivity observed is removed by chemical means and is probably due to radioactive impurities. W. E. P.

3461. Separation of Elements 88 (Ra), 89 (Ac), and 90 (Th) by means of Organic Solvents. M. Haissinsky. *Comptes Rendus,* 196. *pp.* 1788–1789, *June* 12, 1933.—The method is based on the comparative solubilities in ethyl alcohol and precipitabilities from such solutions by pyridine of the nitrates of ThX, MsTh2 and Th. An aqueous solution of 3–4 mg. $Ba(NO_3)_2$ containing MsTh1 with its disintegration products MsTh2, RdTh, ThX and active deposit, together with 3–5 mg. $La(NO_3)_3$, is evaporated to dryness on a water-bath and extracted with 4 cc. alcohol. The insoluble portion contains the Ba, MsTh1, and ThX with 5–10 % of the MsTh2 and 2 % of the RdTh. 3 mg. crystalline thorium nitrate and 4–5 cc. pyridine are then added, when the Th and RdTh with about 7 % of the MsTh2 are precipitated, leaving in the filtrate the lanthanum and most of the MsTh2. Two or three repetitions complete the separation. Active deposit passes mainly into the filtrate, whence it is separated by adding lead nitrate to the alcohol-pyridine solution and then passing in H_2S; the La and MsTh2 are then separated as hydrate or oxalate. ThX is converted into iodide, dissolved out by acetone, and deposited electrolytically on a Ni or Pt kathode. C. A. S.

3462. Recoil Atoms in Gaseous Media: Electronic Affinity. L. Goldstein. *Comptes Rendus,* 196. *pp.* 1792–1793, *June* 12, 1933.—The conclusion that the electron affinity of the gaseous medium is the cause of the variation in yield of activation at a kathode [see Abstract 3506 (1931)] is confirmed by determining this yield for (*a*) a mixture of helium and oxygen containing $0 \cdot 1$ % O_2 at pressures of 51–253 mm. Hg (34–$52 \cdot 5$ %), and (*b*) of mixtures of neon and oxygen at 440 mm. Hg, the partial pressure of O_2 varying from 0 to $0 \cdot 05$ (32–84 %). These variations are attributed to the probability of an ionised recoil atom capturing one or more electrons and so becoming neutralised, being less the greater the electronic affinity of the gaseous medium, *i.e.*, the fewer free electrons it contains. C. A. S.

3463. Action of Radon on Unsaturated Hydrocarbons. Part III. G. B. Heisig. *Am. Chem. Soc., J.* 55. *pp.* 2304–2311, *June*, 1933.—The number of molecules of vinylacetylene and butadiene condensing per α-particle from radon is found to be 10·8 and 9 respectviely. The $(\Delta(H_2 + CH_4))/-\Delta HC$ for these hydrocarbons is very low—practically the same as acetylene. The predicted value of the $-M/N$ value for vinylacetylene agrees with the experimental value but there is no correspondence in the case of butadiene. The vapour pressure of butadiene has been determined at a number of temperatures and the data have been fitted to a linear equation. The boiling point is found to be −4·6°. [For Part II see Abstract 4360 (1932).] AUTHOR.

3464. Fine Structure of Magnetic Spectrum of α-Particles from Radioactinium and its Derivatives. (Mme.) P. Curie and S. Rosenblum. *Comptes Rendus*, 196. *pp.* 1598–1600, *May* 22, 1933.—The following revised and additional data for the intensities and recoil energies (in ekV) of the α-particle lines of Rd-Ac, Ac-*X* and An are given. The figures in brackets give the numbering of the lines previously adopted [see Abstract 3312 (1932)] :—

Radioactinium.

Line.	*Intensity.*	*Energy.*	*Line.*	*Intensity.*	*Energy.*	*Line.*	*Intensity.*	*Energy.*
0(1)	80	6159	4	5	6030	8	15	5847
1(2)	15	6127	5(4)	10	5975	9(6)	60	5822
2(3)	100	6097	6	5	5921	10(?)	10	5776
3	15	6075	7(5)	80	5869			
			Actinium *X*					
0	6	5823	1(1)	4	5709	2(2)	1	5634
			Actinon					
0	—	6953	1	—	6683	2	—	6556

The resultant energy differences for Rd-Ac and An show improved agreement with the energies of corresponding γ- and β-rays respectively. [See also Abstract 3802 (1932).] C. A. S.

3465. α-Radiation of Radiothorium and its Derivatives. S. Rosenblum and (Miss) C. Chamié. *Comptes Rendus*, 196. *pp.* 1663–1664, *May* 29, 1933.—Using a source from which polonium had been removed it is shown that the weak ray, α_x $1{\cdot}594_2$ [see Abstract 3311 (1932)], is probably due to that element. The following revised figures for velocities (in 10^{-9} cm./sec.) are given : RdThα_0 $1{\cdot}615_0$, α_1 1·602 ; Tn $1{\cdot}738_6$; ThX $1{\cdot}653_4$; ThA $1{\cdot}805_1$, in close agreement with other recent results [see Abstracts 2322 and 2323 (1933)]. C. A. S.

3466. Absolute Speed of the Principal Groups of α-Particles. S. Rosenblum and G. Dupouy. *J. de Physique et le Radium*, 4. *pp.* 262–268, *May*, 1933.—α-particles from ThC, ThC′, RaC′, RaA, AcC, and Po were investigated by means of the large electromagnet under improved geometrical conditions so that the probable error in the determination of the radius of curvature should be less than the error in the determination of the magnetic field. A carefully constructed search coil was used in conjunction with a Grassot fluxmeter for the determination of the magnetic field, special precautions being taken to ensure the rotation of the coil through exactly 180°. An absolute measurement of the field was made at all points in the equatorial plane of the gap. The greatest value of $\Delta H/H$ was 1 % (H = the magnetic field). The results obtained for the speed of the α-particles agree very well with the relative determinations made by Rutherford and Briggs. J. E. R. C.

3467. Radioactive Contamination of Ionisation Chamber Materials. J. A. Bearden. *Rev. Sci. Instruments,* 4. *pp.* 271–275, *May,* 1933.—A determination of the number of α-particles emitted per unit area per unit time by materials usually used in the construction of ionisation chambers has been made. The radioactive contamination of a few gases was examined and methods of removing radioactive material from surfaces were investigated. A FP54 vacuum tube, operated at about one-tenth of the maximum sensitivity, was used with a photographic recorder for detecting the α-particles. With this sensitivity α-particles of a range in air of 2 mm or more could be detected. Cold rolled steel which emitted about 3 α-particles per 100 cm.^{2} per hour was the freest from contamination of any material examined. Brass and copper were the next best materials. Careful sandpapering of a surface was very effective in removing radioactive material. It was also found that a clean surface when exposed to air became contaminated. This made it necessary to keep such surfaces in an atmosphere of nitrogen or some gas which was free from radioactive contamination. Celluloid which was cleaned with alcohol and painted with good drawing ink made a satisfactory material for ionisation chamber windows. Amber emitted no more α-particles than steel but pyrex glass emitted about 5 times as many α-particles as steel. Methyl bromide, good quality carbon dioxide, and nitrogen were found to be suitable gases for filling ionisation chambers. AUTHOR.

3468. Photographic Method of Determining Absorption of β-Rays. (Miss) R. Macaigne. *Comptes Rendus,* 196. *pp.* 1993–1995, *June* 26, 1933.—The absorption by aluminium of β-rays from RaD+E determined photographically (method described in detail) agrees with that determined by means of an ionisation chamber, and supports the value 16·9 for μ/ρ of Al for β-rays from RaE. [See Abstract 377 (1928).] C. A. S.

3469. Nuclear Diffusion of γ-Rays. E. Stahel and H. Ketelaar. *Comptes Rendus,* 196. *pp.* 1664–1666, *May* 29, 1933.—γ-Radiation from radium was allowed to fall on thick and thin screens of lead, iron, tin, and aluminium, and the radiation diffused at angles of from 80° to 135° measured. This consists of varying proportions of (*a*) radiation due to the Compton effect, and (*b*) of radiation of nuclear origin. Thick screens gave a maximum of diffused radiation rich in hard components, thin ones radiation of approximately unaltered composition. A thick screen of lead gave 65 % of (*b*) consisting of two components of wave-lengths 17 and 31X; iron and tin yield smaller proportions of (*b*) which vary with the direction, being for iron about 10 % at 130°, the wave-lengths are respectively 23 and 22X; aluminium gives only (*a*). With thin screens lead gave the same components as with thick, but in the ratio 1 : 4·5; results with aluminium agree with the Klein-Nishina formula. Deductions as to the coefficient of photoelectric absorption agree with the results of others. C. A. S.

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3470. Transition Effects of γ-Rays. G. Guében and L. Hermans. *Comptes Rendus*, 196. *pp*. 1789–1791, *June* 12, 1933.—γ-Rays from radium after passing through 5 cm. lead were passed through varying thicknesses of lead, aluminium, or of both, and the absorption, measured by an ionisation chamber, plotted against the thickness of additional metal. Comparing electronically equivalent thicknesses the additional metal if about 0·1 cm. thick, causes an increase in ionisation (less for Al than for Pb), followed, as the thickness interposed increases, by a more rapid decrease than in its entire absence, but always tending to the same limit. This behaviour is similar to that of cosmic radiation. [See Abstract 934 (1932).] C. A. S.

3471. Secondary Effects in Ionisation by Hard γ-Rays. E. J. Workman. *Phys. Rev.* 43. *pp*. 859–870, *June* 1, 1933.—The observations presented in this paper show that the ionisation produced in a counting chamber by γ-rays from a given source depends in a complicated way upon : (*a*) the nature (atomic) and thickness of the walls of the chamber ; (*b*) the nature, amount, and distribution of matter near the chamber. When the walls are sufficiently thick to stop the secondary β-particles (the actual effective ionising agencies) the secondary influences from the outside are greatly reduced, and the uncertainties involved among measurements with different thicknesses of the same wall material may be no more than a few per cent. The results emphasise the effects of nuclear scattering of the secondary β-particles. This action is effective in any material from which β-rays may pass to the gas of the chamber, and consequently, the atomic properties of any such materials must be considered in interpreting ionisation measurements. The following effects of nuclear scattering are discussed in their relation to ionisation measurements : (1) equilibrium conditions between primary and secondary radiation with attention to the effects of " filtering " ; (2) reflection of the secondaries by the wall material ; (3) the dependence of the " stopping power " for electrons, of the wall on the atomic number of the material. In the second part of the paper, the front and back wall effects are treated separately. Transition effects between different materials on the front wall are shown. These transition curves are discussed in connection with " stopping power," equilibrium conditions, and photoelectric conversion of the γ-radiation. The bearing of these phenomena on measurements of γ-radiation with different counting chambers is discussed. AUTHOR.

3472. Protons and Positive Electrons. H. Mandel. *Phys. Zeits. d. Sowjetunion*, 3. 5. *pp*. 551–553, 1933. *In English*.—Possible mutual relations between the known kinds of elementary particles (electrons, positive electrons, protons and neutrons) and photons are discussed from the point of view of Dirac's theory of " holes." J. E. R. C.

3473. Origin of Positive Electrons. Irène Curie and F. Joliot. *Comptes Rendus*, 196. *pp*. 1581–1583, *May* 22, 1933.—Previous experimental work [see Abstract 2919 (1933)] indicates that positive electrons emitted from lead under bombardment from a Be-Po source are not produced by neutrons. The authors are led by further experiments to suggest that these electrons have their origin in the interaction of the γ-ray with the lead nucleus. By annihilating the γ-ray quantum without exciting the nucleus, a positive electron and a negative electron might be produced. This is shown to be in agreement with the known facts of the nuclear absorption of γ-rays. Experimental evidence was obtained of the production of positive electrons by bombarding lead with the hard

γ-radiation from ThC''. It is, however, suggested that, instead of γ-rays, neutral particles of electronic mass are responsible for the production of the positive electrons. J. E. R. C.

3474. Electron Spin and Theory of the Neutron. W. Wessel. *Zeits. f. Physik*, 82. 7–8. *pp.* 415–444, *May* 15, 1933.—The completion of the Dirac equation by a spin potential term is investigated with special reference to its influence upon the fine structure of the spectral lines of hydrogen. This term is shown to agree to the necessary degree of accuracy with the "ungeraden" part of the Coulomb potential as defined by Schrödinger. In consequence the fine structure is not affected. The additional term gives rise to a series of otherwise forbidden eigenfunctions which correspond to energies $-mc^2$ and represent electron states in the immediate neighbourhood of the nucleus (circa 10^{-13} cm.). The author attempts to correlate these eigenfunctions with the neutron. The distribution of charge is approximately that of a hydrogen atom reflected in a sphere of radius 10^{-11} cm., and at small distances has a potential of a dipole character. The mass defect can be obtained, and by estimating the collision radius of the neutron, the mass defect is obtained exactly of the observed order of magnitude. In the case of hydrogen eigenfunctions, Dirac's theory appears to be slightly incomplete. J. E. R. C.

3475. Ionisation of Gases by Neutrons. T. W. Bonner. *Phys. Rev.* 43. *pp.* 871–874, *June* 1, 1933.—The ionisation currents produced in hydrogen, helium, nitrogen, methane, ethylene and argon by the neutrons from beryllium have been measured for gas pressures from 5 to 80 atmospheres. The relative diameters of the atomic nuclei have been calculated from the relative ionisations. Assuming that the radius of the neutron is small compared to the radii of the atomic nuclei, the relative radii of the nuclei are found to be $r_{\mathrm{H}} = 1\cdot 0$, $r_{\mathrm{He}} = 1\cdot 4$, $r_{\mathrm{N}} = 1\cdot 9$, $r_{\mathrm{C}} = 2\cdot 8$, and $r_{\mathrm{A}} = 4\cdot 1$. The target areas of the nuclei $a_{\mathrm{H}} = 1\cdot 0$, $a_{\mathrm{He}} = 2\cdot 0$, $a_{\mathrm{N}} = 3\cdot 5$, $a_{\mathrm{C}} = 8\cdot 0$, and $a_{\mathrm{A}} = 17$, vary roughly as their atomic numbers. The pressure-ionisation curves for neutrons are found to differ from the γ-ray curves in the same gases. AUTHOR.

3476. Atomic Disintegration by Proton Bombardment (Canal Rays). F. Kirchner. *Naturwiss.* 21. *pp.* 473–478, *June* 23, 1933.—By means of an impulse generator, a condenser of capacity 0·02 mfd. is charged to a potential of 40–60 kV: a discharge tube is placed vertically above an expansion chamber and the condenser discharged at the instant of expansion. The protons traverse a canal 6 cm. long and 3 mm. wide, and impinge on a sheet of Li supported in the centre of the chamber and separated from the surrounding gas by a mica cage having a stopping power for α-particles of 1 cm. of air. Cockcroft and Walton's conclusions are confirmed, the Li atom splitting into two He atoms projected in diametrically opposite directions except for the small forward component due to the initial momentum of the bombarding proton. The production of He atoms of range 8·5 cm. is confirmed, but no evidence is found for the existence of short-range particles. In contrast to Li, with B a continuous disintegration spectrum is obtained ranging from 1·2 to 5 cm. In the transformation $\mathrm{B}_{11} + \mathrm{H}_1 \rightarrow 3\mathrm{He}_4$, the newly-formed α-particle is usually of very short range, although, in agreement with the conservation of momentum, the angles between the three branches are all approximately 120°. F. C. C.

See also Abstract 3280.

RADIATION.

ABSORPTION AND TRANSMISSION.

3477. Purification and Ultra-Violet Transmission of Ethyl Alcohol. L. Harris. *Am. Chem. Soc., J.* 55. *pp.* 1940–1942, *May*, 1933. —The preparation of pure absolute alcohol from commercial absolute alcohol is discussed. The values for ultra-violet absorption from 2450–2120 Å are given, and are a reliable indication of purity. N. M. B.

3478. Christiansen Filter for Ultra-Violet Light. K. v. Fragstein. *Ann. d. Physik*, 17. 1. *pp.* 22–40, *May*, 1933.—If mixed light passes through a suitable liquid which contains a coarse powder of some transparent solid substance the light which emerges in the direct beam is markedly monochromatic. This effect, discovered by Christiansen, is used to construct a filter in the ultra-violet. A mixture of 56 % of pure benzol and 44 % of alcohol with quartz particles is found to act effectively as a filter for the region round about 3000 Å. By means of a convenient method of regulating the temperature of the filter the point of maximum transmissibility may be varied over a certain range. The maximum transmissibility depends on the wave-length and varies, for example, in the region 3700 to 3000 Å from 65 to 25 %. H. L. B.

3479. Silver Filter for Ultra-Violet Light. G. C. Brock. *Roy. Dublin Soc., Proc.* 20. *pp.* 563–566, *June*, 1933.—A method is described for preparing filters for the Hg 3130 Å line from a photographic lantern plate, which are much superior to the sputtered or chemically deposited silver films normally used. The filtering action is attributed to the presence of colloidal silver, and this, deposited in particles of different sizes, gives filters of different colours which all have a maximum of transmission near 3000 Å. Reddish brown filters, having a high absorption in the blue-violet, are most efficient, especially for work involving the photography of fluorescence. C. B. A.

3480. Optical Absorption in Radiating Substances by the Alternating Light Method. F. G. Houtermans. *Zeits. f. Physik*, 83. 1–2. *pp.* 19–27, *June* 6, 1933.—The optical absorption coefficients of atoms and molecules in excited states are of importance, but direct measurement is complicated by the fact that the material emits at the precise wave-length of most interest. A direct method is now proposed, and some of its applications discussed, data being given to show that it is quite practicable. The principle is to use an intermittent source, and (by means of a photoelectric cell and thermionic amplifiers) to measure the intensity after absorption in such a way that continuous radiation is disregarded by the detecting instrument. J. H. A.

See also Abstracts 3422, 3493, 3509, 3528, 3529, 3530, 3686.

COLORIMETRY.

See Abstracts 3621, 3622.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3481. Dispersion of Electric Birefringence of Ethyl Ether. M. Schwob. *Comptes Rendus*, 196. *pp.* 1383–1384, *May* 8, 1933.— Chaumont's method together with the stroboscopic installation already described [see Abstract 3705 (1932)] have been employed for the purpose, and, as a result, the dispersion for ethyl ether relative to that of CS_2 is found to be normal, *i.e.*, to be in accordance with Havelock's law.

H. H. Ho.

3482. Theory of the Kerr Effect of Diatomic Molecules. T. Neugebauer. *Zeits. f. Physik,* 82. 9–10. *pp.* 660–673, *May* 23, 1933.—It is shown that the quantum mechanical theory of the Kerr effect, apart from refinements, yields the classical formula, if for the statical and optical polarisability the corresponding quantum theoretical expressions are inserted, so that the polarisabilities calculated with help of the Kerr effect from experimental data are also correct according to quantum mechanics.

J. J. S.

3483. Molecular Orientation of Molecules with Permanent Moment in an Alternating Field. Application of the Dispersion of the Dielectric Constant and the Kerr Effect. Y. Rocard. *J. de Physique et le Radium,* 4. *pp.* 247–250, *May,* 1933.—A purely mathematical discussion of the subject of the title. The function of the distribution of the molecular orientations of the molecules with permanent moment in an alternating field is deduced and shown to be given in quantities of the order of μ^2 neglecting the terms in μ^3 and above. A theory of dispersion in the Herzian range is developed together with the theory of the Kerr effect in an alternating electric field.

S. G. B.

3484. Theory of Depolarisation, Optical Anisotropy and the Kerr Effect. R. Serber. *Phys. Rev.* 43. *pp.* 1003–1010, *June* 15, 1933.—The usual classical theory of optical anisotropy, based on a molecular model which considers a molecule as a set of anisotropic harmonic oscillators, leads to the formula $\Delta = 6\delta^2/(5 + 7\delta^2)$ for the depolarisation of scattered light. Here δ^2 is the optical anisotropy. For the Kerr constant of nonpolar molecules it gives the formula $K = 3\delta^2(n^2 - 1)(\epsilon - 1)/40\pi NkT$. A critical examination of the theory shows that these equations can be true only in two limiting cases, in both of which it is possible to define δ^2 in a way which makes it independent of the frequency of the incident light. The first case is characterised by the condition that the index of refraction be representable by a one term Sellmeier formula. The second case arises when the anisotropies of the individual absorption lines are all approximately equal. The above restriction does not seem to be generally realised; at least it is not ordinarily stated in the literature. General formulæ are derived by quantum theory for the depolarisation of light scattered by molecules, including the Raman scattering, and for the Kerr constant. It is shown that the above formulæ are valid quantum-mechanically under the same conditions for which they hold classically. The quantum proof is much more general, in that no particular molecular model is assumed.

AUTHOR.

3485. Magnetic Birefringence in Liquid Mixtures. S. W. Chinchalkar. *Indian Journ. Phys.* 7. *pp.* 491–518, *May* 20, 1933.—Twenty-one binary liquid mixtures have been studied. The double refraction was estimated by measuring the shift of the dark band in Rayleigh's bent glass plate compensator. Curves for aniline, benzene, and toluene are concave towards the axis of concentration (in partial volumes), those for ethyl-, bromo- and chloro-benzenes are nearly straight, while those for CS_2 and nitrobenzene are convex, the gradual variation in the curvatures following the above order of the liquids; the different liquids mixed with the above change the curvatures slightly, keeping the essential features the same; there is an asymmetry in the curves for aniline. The curves to be expected on Langevin's theory are also drawn. The experimental curves are correlated with the existing data on (1) temperature variation of magnetic birefringence, (2) temperature variation of molecular optical anisotropy and (3) optical anisotropy in the vapour and liquid states. From the striking correspondence between these different data, it is suggested that the variation in the effective optical anisotropy of the molecules with dilution is at least one, and probably the main cause of the deviations observed in the birefringence in mixtures. The physical interpretation of the variations is discussed. AUTHOR.

3486. Magnetic Birefringence of Cerium Salts in Aqueous and Non-Aqueous Solutions. C. Haenny. *Comptes Rendus,* 196. *pp.* 1297–1298, *May* 1, 1933.—The variation of magnetic birefringence with concentration is studied in aqueous and alcoholic solutions of cerous nitrate, chlorate and sulphate. For nitrate and chlorate in water, the effect is not proportional to concentration, and in the nitrate is much stronger than in the other salts. Addition of nitric acid to the nitrate solution reduces the birefringence considerably, and the change cannot be attributed to the simple subtraction of the effect of the free acid (birefringence of opposite sign to that of the salt). Alcoholic solutions of cerous nitrate and chlorate show strong magnetic birefringence. Oxidation to ceric nitrate results in only a very feeble birefringence. The magnetic moments of ceric salts are also much smaller than those of cerous salts, so that for cerium, magnetic birefringence and paramagnetism appear to depend essentially on the presence of the electron which is removed from the cerous ion on oxidation. C. B. A.

3487. Magnetic Double Refraction of Liquid Oxygen. P. Lainé. *Comptes Rendus,* 196. *pp.* 1218–1220, *April* 24, 1933.—At a temperature of 89·8° K. the magnetic double refraction of liquid oxygen was found to be 1·96 times that of nitrobenzene at 17° C., instead of 1·85 as announced by Zernike. [See following Abstract.] E. E. F. d'A.

3488. Temperature Variation of Magnetic Double Refraction of Liquid Oxygen. P. Lainé. *Comptes Rendus,* 196. *pp.* 1594–1596, *May* 22, 1933.—The ratio of the magnetic double refractions of liquid oxygen at 77·0 and 90·1° Abs. as deduced from Langevin's theory for paramagnetic substances agrees with experimental results. But his theory for the magnetic susceptibility, based on the same fundamental ideas, gives for the ratio of the susceptibilities at the same temperatures a result double the experimental. This is attributed by Weiss to the molecular field, but such cause should affect to the same extent the magnetic double refraction also, unless its effect is exactly counterbalanced by change in optical anisotropy with temperature, as in the cases of formic and acetic acids. [See preceding Abstract.] C. A. S.

3489. Paramagnetism and Magnetic Birefringence of Oxygen Gas and Liquid. L. Goldstein and Y. Rocard. *Comptes Rendus,* 196. *pp.* 1722–1724, *June* 6, 1933.—At temperature T, the molecular susceptibility of oxygen (gas or liquid) is inversely proportional to $T + \theta$, where θ is a positive constant equal to 40ρ, ρ being the density. The magnetic birefringence of oxygen gas has not been measured, but is certainly much lower than the value predicted by Langevin's theory. That of the liquid at 90°·6 K. is negative and equal to 1·95 times that of nitrobenzene under ordinary conditions. Assuming that the molecule O_2 is in a $^3\Sigma$ state, the susceptibility of the gas can be explained satisfactorily, the magnetic moment being entirely due to spin and corresponding to $2\sqrt{2}$ Bohr magnetons; but using this value to calculate the magnetic birefringence of the liquid on Langevin's theory, a result 200 times too large is obtained. These facts can be explained on a new hypothesis, based on Kramers' interpretation of the triplet structure of certain O_2 bands, as due to the rotation states corresponding to three projections $\sigma = +1, 0, -1$ of resultant spin on the axis of rotation. It is now assumed that transitions from one σ state to another can take place in the same molecule, and that such transitions are extremely frequent during collisions. It follows that the distribution of molecular orientations in a magnetic field will differ profoundly from the Boltzmann-Langevin function. A change of state σ once in six collisions, one molecule in 3 being in a $\sigma = \pm 1$ state, is sufficient to explain numerically the magnetic birefringence and the paramagnetism of O_2. C. B. A.

3490. Thermal Variation of Abnormal Magnetic Birefringence. R. Lucas. *Comptes Rendus*, 196. *pp.* 1657–1659, *May* 29, 1933.—It is confirmed mathematically by a method similar to that employed in regard to similar variations in ordinary rotatory power [see Abstract 1560 (1928)] that the assumption of the presence of two or more isomers of different birefringences of the same or different sign explains the abnormal variation [see Abstract 2352 (1933)]. C. A. S.

3491. Magneto-Optical Dispersion of Organic Liquids in the Ultra-Violet. Part V. Normal Propyl Propionate, Isobutyl Acetate, Ethyl Acetoacetate, and Ethyl Oxalate. A. de M. Beanland and E. J. Evans. *Phil. Mag.* 15. *pp.* 905–929, *May*, 1933.—The ordinary and magneto-optical dispersions of the substances mentioned have been determined in the visible and ultra-violet regions. The magneto-optical dispersion is represented in each case by an equation of the type $n\delta = \kappa\lambda^2/(\lambda^2 - \lambda^2_1)^2$, where n is the refractive index and δ Verdet's constant at wave-length λ, λ_1 the wave-length of the ultra-violet absorption band, and κ a constant for each liquid which ranges from $5{\cdot}21 \times 10^{-3}$ to $5{\cdot}67 \times 10^{-3}$. The ordinary dispersion is represented by $n^2 - 1 = b_0 + b_1/(\lambda^2 - \lambda_1^2)$, where b_0 and b are constants, which have been determined, for each liquid. The ratios of charge to mass of the resonators, e/m, are: *n*-propyl propionate, $0{\cdot}99 \times 10^7$; *iso*-butyl acetate, $1{\cdot}01_5 \times 10^7$; ethyl acetoacetate, $0{\cdot}87 \times 10^7$; ethyl oxalate, $0{\cdot}91 \times 10^7$ e.m.u. [For Part IV see Abstract 2377 (1932).] H. F. G.

3492. Magneto-Optical Dispersion of Acetic Acid and Normal Propyl Acetate. W. J. Lewis and G. E. Jones. *Phil. Mag.* 15. *pp.* 1065–1079, *June*, 1933.—Refractive indices and Verdet's constants for acetic acid and normal propyl acetate are recorded for a number of visible and ultra-violet wave-lengths. For each substance the two quantities can be represented by equations of the type previously employed [see Abstract 2377 (1932)], in which the dispersion constants are identical. Values of e/m are also deduced in each case. C. B. A.

3493. Magnetic Circular Dichroism of Aqueous Solutions of Cobalt Sulphate and Nitrate. M. Schérer and R. Cordonnier. *Comptes Rendus*, 196. *pp.* 1724–1727, *June* 6, 1933.—The magnetic circular dichroisms exhibited by solutions of cobalt sulphate and nitrate are measured in continuation of previous work on the chloride. In all three cases the circular vibrations having the same sense as the amperian currents are the less absorbed. The dichroism curves are similar, with a maximum at $\lambda = 5100$ Å, and the dichroism of a solution is found to be directly proportional to the concentration. The ratio of ellipticity to concentration is the same for each salt, so that the ellipticity is independent of the nature of the anion. The curves of magnetic rotatory dispersion confirm the results of Roberts and of Miescher. Those for the sulphate and nitrate have two points of inflexion and thus suggest a more complex structure of the bands of these salts. [See also Abstract 562 (1933).] **Errata.** *Ibid. p.* 1932, June 19, 1933. C. B. A.

See also Abstract 3343.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3494. Relation between Fluorescent Intensity and Wave-Length of Exciting Light. W. Fabrikant. *Phys. Zeits. d. Sowjetunion*, 3. 6. *pp.* 567–573, 1933. *In German.*—Measurements on the variation of intensity of fluorescence of fluorescein, aesculin, quinine sulphate and uranyl nitrate with wave-length of exciting light by means of a monochromator and photometer show that the efficiency is proportional to the wave-length of the exciting light in accordance with the Einstein law. Departures from this relation are accounted for by absorption of the solvent and of the fluorescent substance. J. E.

3495. Emission of Phosphors. Part III. Behaviour of Samarium in the Oxides of Group II. R. Tomaschek and O. Deutschbein. *Ann. d. Physik*, 16. 8. *pp.* 930–948, *April*, 1933.—The object here is to obtain quantitative results for the changes in the spectra of the rare earths (samarium in particular) in various kinds of materials used as bases, namely, CaO, SrO, BaO, MgO and BeO, and so to gain information about the atomic fields in these substances; the significance of these atomic fields for the theoretical interpretation of emission spectra of substances in the solid state is also determined. The excitation was produced either by means of an arc light or kathode rays of about 30,000 volts. The times of exposure varied from a few minutes (in the case of CaO) to several hours. The plates were in most cases super-sensitised by means of ammonia. It is found that the structure of the emission spectra of the samarium ion in the above substances depend on the previous history of the preparation and on the crystalline structure. [For the preceding Parts see Abstract 1579 (1928).] H. L. B.

3496. Relation between Emission and Absorption Spectra of Salts of Rare Earths in the Solid State. Part I. Phosphor Activated by Rare Earths. R. Tomaschek and O. Deutschbein. *Zeits. f. Physik*, 82. 5–6, *pp.* 309–327, *May*, 1933.—In phosphors which show sharp lines in emission (*i.e.* those activated by Cr, rare earths and the uranyl salts) there are two kinds of absorption. One obviously related to the light centre, another not so related, but attributed to a molecular complex to which the light centre is attached. This present work has shown that in spite of differences in the emission and absorption spectra of the rare earth activated phosphors there is yet a close relationship. Thus all the strong emission lines derive from a level associated with a strong absorption line group, the strong lines being coincident. For shorter wave-lengths there appear to be displacements due to temperature displacements of levels. The infra-red absorption appears to correspond to a similar emission but no emission corresponding to far ultra-violet absorption has yet been observed. The emission of pure rare earths discovered accidentally in the course of the above work will be dealt with in Part II. J. E.

3497. Fluorescence of Pure Salts of Rare Earths. R. Tomaschek and O. Deutschbein. *Phys. Zeits.* 34. *pp.* 374–376, *May* 1, 1933.—The rare earths incorporated in a colourless base in dilution of ·001 to 1 % showed marked phosphorescence under short wave-length or kathode rays. It has been found that the pure salts show fluorescence—at least in some cases. Europium salts in Sm salts show a spectrum which differs from that of pure europium salts only by a shift of the lines of 1 cm^{-1}. Diagrams are given showing that similar results are obtained with Sm, Tb and Dy—pure and in solution. These results show that the emission of phosphors activated by rare earths comes from the rare earths themselves: which are therefore like the uranyl salts and the platinocyanides. Eu and Dy salt solution in water show narrow bands corresponding to the uranyl lines, but other rare earth solutions in water are weaker and give no indication of such correspondence. It is considered that the brightness with Eu salts is due to the stability of the outer electron configuration. [See preceding Abstract.] J. E.

See also Abstracts 3591, 3592.

INTERFERENCE. DIFFRACTION AND SCATTERING.

3498. Diffraction of Light by Ultrasonic Sound Waves. R. Bär and E. Meyer. *Phys. Zeits.* 34. *pp.* 393–396, *May* 15, 1933.—A method is described whereby the diffraction of light by ultrasonic waves in liquids can be used to demonstrate the spreading of the sound beam photographically. The wave-length of the sound can be determined by a new diffraction method employing a wire grating, the results being in agreement with those obtained by considering the diffraction of light by the sound waves. G. G. S.

3499. Occurrence of Interference Patterns with Uniform Grating Images in the Refraction Field of a Strip Grating. H. Weisel. *Ann. d. Physik*, 17. 3. *pp.* 251–277, *June*, 1933.—A difference occurs with line and strip gratings in that with the former the distance between the lines is negligible in comparison with the path, but for the latter it cannot be neglected in calculations of the intensity. For line gratings the investigation of changes of intensity in different parallel planes has been theoretically and experimentally related to the plane of the grating and complete agreement resulted. Formerly this treatment applied only to the simplest case for step gratings where the above results held and the intensity equations were not set up. In the present paper the author develops the intensity equations for the strip grating with very large slit numbers in characteristic parallel planes. The function curve of the equation confirms that the refraction pattern is an adequate image of the grating and the intensity is given by a Fourier cosine series while the intensity distribution is limited as in the two planes investigated. The earlier observations are in complete agreement with this result. A series of equations composed of infinite series are also developed from functions of the basic form $(\sin u)/u$ which have constant limiting values and which occur as coefficients of certain Fourier cosine series. R. S. R.

See also Abstracts 3357, 3398, 3524, 3655.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3500. Photosynthesis of Hydrogen Chloride. Part III. Mixtures containing Oxygen. R. G. W. Norrish and M. Ritchie. *Roy. Soc., Proc.* 140. *pp.* 713–740, *June* 1, 1933.—The kinetics of the photochemical combination of hydrogen and chlorine in presence of large or small proportions of oxygen have been re-examined by the new technique [see Abstract 2961 (1933)]. The hydrogen chloride produced exerts a powerful inhibiting effect [see Christiansen, Abstract 2630 (1929)]. Hydrogen also inhibits, but to only one-fourth the extent, and the quantum efficiency passes through a maximum as the pressure of hydrogen is increased. In oxygen-rich mixtures the quantum efficiency is inversely proportional to the pressure of oxygen and independent of the intensity of the absorbed light, but the quantum efficiency becomes increasingly dependent on the light intensity as the pressure of oxygen is reduced. By an extension of the Nernst scheme of reactions adopted for oxygen-free mixtures (*loc. cit.*) to include ternary and binary reactions of hydrogen atoms with oxygen molecules, an expression is obtained which takes account of all the facts and allows of the accurate calculation of the quantum efficiency of any mixture. The values so found vary from 10^5 to 20. The expression reduces to one similar to the hydrogen-bromine formula of Herzfeld, Christiansen, and Polanyi for oxygen-free mixtures and virtually to Chapman's formula for oxygen-containing mixtures. T. H. P.

3501. Fine Grain Development. H. Funk. *Zeits. f. wiss. Phot.* 32. *pp.* 83–96, *June*, 1933.—Describes methods used, and results obtained from such examinations carried out in order to ascertain whether, under comparable conditions, the developer influences the grain size. Four methods were tried—magnification of photographs of Mee's test-object, grain counting by size, subjective measurements of spectral blackening by different colours, grain variations measured by a registering photometer. The results obtained from the last three methods show that, with the same lighting and blackening, the fine grain developer produces a somewhat smaller grain in the same photographic layers. R. C. F.

3502. Photochemical Behaviour of Halogen Silver Emulsions to New Desensitisers and Developers. G. Kraft. *Zeits. f. wiss. Phot.* 31. *pp.* 329–364, *May*, 1933.—Examines the dependency of the constitution of new desensitisers and developers on the photochemical action caused by them. The results obtained, using 91 different substances, are given, these results being obtained from an examination of the effects of each material on silver chloride papers, and silver bromide and iodide plates after a short exposure to the light from a mercury arc, their action on the latent image, the desensitisation action, the power of development, and the fog-delaying action of the materials examined. It is possible by means of such an examination to make a definite prophecy regarding the photochemical properties of any material. Of the materials examined a large number show good desensitisation properties whilst a few can be used as developers. R. C. F.

3503. Performance of Photographic Layers in the Spectrography of all Wave-Lengths. J. Eggert. *Zeits. f. techn. Physik*, 14. 5. *pp.* 177–186, 1933.—Examines the performance of photographic layers in spectrography from three photographic points of view—sensitivity, blackening curves, diffusion. From a consideration of published data the method of estimating the sensitivity of photographic layers which is most suitable to the requirements of physics is discussed. Sensitisation and hypersensitisation are dealt with, as is the sensitivity of photographic layers to X-rays, kathode and other rays. With reference to the blackening curves it is shown that there is no possibility of obtaining a general analytical representation of such curves. The Schwarzschild's interpolation formula and the exponent p are considered, this exponent having a value of unity for X-rays. The dependence of the γ value on the wave-length, and the sources and limits of errors occurring in photographic intensity measurements are also discussed. The diffusion of the photographic image and its dependency upon the fixing material, grain size and resolving power is dealt with, curves of the resolving powers and their influence on the reproduction of spectral lines being given. Finally, the edge effect is briefly discussed. R. C. F.

3504. Recent Advances in Sensitisers for Infra-Red Photography. L. G. S. Brooker, F. M. Hamer and C. E. K. Mees. *Kodak Research Lab. Comm. No.* 513. *Phot. J.* 73. *pp.* 258–264, *June*, 1933.—The history of the subject is surveyed and the preparation and constitution of the various dyes which have been successfully employed are given. The nature and characteristics of the recently discovered groups are given in detail; wedge spectrograms illustrate the advances which the various dyes have rendered possible. A. H.

3505. Increase in Sensitivity of Photographic Emulsions by Electrophoresis. A. Charriou. *Comptes Rendus*, 196. *pp.* 1880–1882, *June* 19, 1933.—The experimental arrangements are described for applying the process of electrophoresis to photographic emulsions, i.e. of separating adsorbed from adsorbing substance and therefore of effecting extremely thorough washing. It is found that the sensitivity of silver bromide is increased thereby to a much greater extent than when water is used alone. The presence of bromine has been established in the residual electrophoresis water but not that of silver. H. H. Ho.

3506. Mechanism of Hypersensitisation. J. I. Bokinik and Z. A. Iljina. *Phot. J.* 73. *pp.* 300–304, *July*, 1933.—The hypersentitising action of silver salts on plates containing sensitising dyestuffs is caused by the photochemical reduction of $AgNO_3$ in presence of the dyestuff during exposure. Metallic silver deposited on the nuclei of the latent image increases the nuclei to developable size. A similar effect has been observed with various basic dyestuffs, including some desensitisers. It is localised preferentially in the spectral region corresponding to the absorption band of the dyestuff used. The mechanism of this phenomenon is identical with the above-described. Acid dyestuffs, which are insensitive to light and do not change the sensitivity of silver bromide, do not give any effect after treatment with silver nitrate. AUTHORS.

See also Abstracts 3355, 3479, 3566, 3614, 3745.

PHOTOMETRY.

3507. Surface Brightness of Light Beacon Projectors. A. Blondel. *Rev. d'Optique*, 12. *pp.* 97–113, *March*, 1933.—Several methods are described for determining the apparent brightness of the exit surface of an optical projector. In practice it is important to determine the brightness in the axial direction, and use only rays which are parallel, or

nearly parallel, to the axis. Three devices can be used: observation of the real image of the bright surface on a diffusing screen, projection of this image directly on to the eye, and use of the virtual image.
W. S. S.

3508. Photoelectric Measurement of Reflecting Power. L. Bergmann. *Zeits. f. techn. Physik*, 14. 4. *pp.* 157–160, 1933.—Describes a reflection meter based on the rectifier selenium cell [see Abstract 4574 (1932)]. A box with an elliptical opening at the bottom has two slanting side openings converging towards the bottom. Into one of these openings a lamp is inserted, while the other holds a rectifier selenium cell. The box is placed on a glass mirror and the current given by the selenium is adjusted to 100 divisions by means of an iris diaphragm controlling the light. On substituting another surface for the mirror, its reflecting power is directly indicated in percentages of totality. A similar method is used for diffused reflection, with a sheet of white paper as the standard. The curve of sensitiveness being very similar to that of the eye, the method is directly applicable to colour. A suitable colour screen has been found which renders colour response practically perfect. E. E. F. d'A.

3509. Photoelectric Comparator for Rapid Measurement of Reflection and Transmission. C. H. Sharp and H. J. Eckweiler. *J.O.S.A.* 23. *pp.* 246–250, *July*, 1933.—An apparatus is described, designed especially for the determination of reflection and transmission factors either in white light or in the various regions of the spectrum. A beam of light emerging from a lamp or from the slit of a monochromator falls at 45° incidence upon a rotating glass disc, one-half of the surface of which is silvered. This splits the beam into two beams passing in alternation over two separate paths and through variable sectors by which their intensity may be decreased in a measurable manner. The sample is placed in one beam. The beams are reunited on the surface of a photoelectric cell, the current of which is amplified. In the output circuit is a vibration galvanometer tuned to the frequency of the two light beams, which is used as a null instrument. A strict substitution method is used in making the measurements. The spectral range which can be covered is determined by the character of the source of radiation, by properties of the optical train and by the response characteristics of the particular photoelectric cell employed. Different cells can be used for different regions. In use, the apparatus has shown itself to be satisfactory from the point of view of high accuracy, rapidity and simplicity of operation. AUTHORS.

3510. New Industrial and Research Spectrophotometer. J. H. Dowell. *Journ. Sci. Instruments*, 10. *pp.* 153–156, *May*, 1933.—The polarising system already described [see Abstract 1598 (1932)], possessing a density scale following the law 4 log tan θ, is incorporated in a new spectrophotometer which is described in detail. The instrument is a development of the earlier Hilger-Nutting spectrophotometer and, in addition to the feature above, many alterations are made so as to render the instrument more convenient for industrial use. Illumination is provided by means of a 100 c.p. "Pointolite" lamp, but a description is given of an alternative sphere illuminator. The methods of use of the instrument for various industrial purposes are briefly considered. A. H.

3511. Photoelectric Spectrophotometer. A. G. Winn. *Faraday Soc., Trans.* 29. *pp.* 689–697, *June*, 1933.—The paper describes a photoelectric spectrophotometer for the measurement of light absorption in the visible and ultra-violet. A null method employing two photo-cells is used. The photo-currents are balanced across a high resistance potentiometer, an electrometer triode being used as a null-reading amplifying voltmeter. Details of the performance are given and the possible errors discussed. **Author.**

3512. Device for Reducing Grain Effects in Microphotometer Records. F. K. Richtmyer and F. R. Hirsh, Jr. *Rev. Sci. Instruments*, 4. *pp.* 353–354, *June*, 1933.—A simple mechanical attachment to the Moll microphotometer is described, whereby the photographic plate under investigation is made to move up and down parallel to the spectrum lines during scanning. In this way more photographic grains are introduced into the scanning spot of light than if the plate were not oscillated, and hence a smoother microphotometric record is obtained. L. A. W.

See also Abstracts 3348, 3445, 3610, 3859.

POLARISATION.

3513. Studies in Optical Activity. Part II. New Type of Polarimeter. C. H. Johnson. *Faraday Soc., Trans.* 29, *pp.* 618–625, *May*, 1933.—A polarimeter has been devised for the special purpose of measuring the rotations of highly coloured solutions with absorption bands in the visible and near ultra-violet. A parallel beam of white light is sent through two nicol prisms inclined at about 55° and is then brought to a focus on the slit of a direct vision spectrometer. When a tube containing cane sugar solution of suitable concentration is interposed, an extinction appears at the wave-length for which the rotation due to the sugar is appropriate. The introduction of a second tube containing the solution under examination produces a measurable displacement of the position of extinction, from which the rotation at the new wave-length can be deduced. Details of calibration, technique, and construction are given, and the application of the method to coloured and colourless solutions is described. C. B. A.

3514. Studies in Optical Activity. Part III. Dextro- and Lævo-Cobaltioxalates. C. H. Johnson and A. Mead. *Faraday Soc., Trans.* 29. *pp.* 626–640, *May*, 1933.—$[Co\,(C_2O_4)_3]^{---}$ has been resolved by means of its strychnine salts, and strychnine *l*-cobaltioxalate has been isolated for the first time. Analyses, absorption spectra and rotatory dispersion are recorded for *d*- and *l*-cobaltioxalates of potassium and strychnine. The curves of rotatory dispersion are not symmetrical with regard to the absorption band, while the distance between the components of the vibrating electric moment giving rise to the optical activity is found to be 20 Å. This high value is discussed in the light of similar results obtain by Kuhn. Solid *l*-strychnine cobaltioxalate racemises completely if kept for a few weeks, but the *d*-salt loses about 25 % of its activity and then remains unchanged. [See also Abstract 1015 (1933) and preceding Abstract.] C. B. A.

3515. Polarising Louvres and their Application. C. F. Smith. *Journ. Sci. Instruments*, 10. *pp.* 212–214, *July*, 1933.—An arrangement of louvres suitably inclined to each other enables, by one or more successive reflections, a beam of polarised light of any area to be obtained, with directional control. Its application to a strain viewer is described. **Author.**

See also Abstracts 3484, 3557.

RADIATION, EMISSION.

3516. Azimuthal Asymmetry of the Cosmic Radiation in Mexico City. T. H. Johnson. *Frank. Inst., J.* 215. *pp.* 749–753, *June*, 1933.—Measurements were made in Mexico City in geomagnetic latitude 29° N. at 2250 m. above sea level. Two independent sets of Geiger-Müller counters were used as triple-coincidence-counting telescopes and the measurements were made in such a way as to compare most effectively the east and the west intensities at the same angles from the vertical. The results show the existence of an azimuthal asymmetry in the radiation of the type predicted by the theory of the latitude effect, and a very important result of the measurements is the fact that the greater west intensity shows that the principal component of the corpuscular radiation in the energy range from 1×10^{10} to 2×10^{10} volts is positively charged. J. J. S.

3517. Investigation of Ultra-Radiation in the Wilson Chamber. P. Kunze. *Zeits. f. Physik*, 83. 1–2. *pp.* 1–18, *June* 6, 1933.—The discussion of previously obtained photographs of ultra-ray tracks is continued. The first part considers the distribution of direction of the ultra-ray tracks at the earth's surface. In the second part the double tracks observed are considered and a division into several classes given. The case of twofold collision is dealt with. In the third part the specific ionisation is investigated by drop counting. J. J. S.

3518. Secondary Effects of Cosmic Radiation. E. Fünfer. *Zeits. f. Physik*, 83. 1–2. *pp.* 92–103, *June* 6, 1933.—By means of a coincidence arrangement of three or five counting tubes examination was made of the amount, penetrating power and absorption coefficient of the secondary radiation liberated in Pb, Fe and Al by the cosmic radiation. This secondary radiation possesses a range of about 18 cm. in water and a mass absorption coefficient of about 0·14 cm.^{2}/gm. The intensities of the secondary radiation from Pb, Fe and Al at the saturation thickness are in the proportion 1 : 0·8 : 0·5. By placing lead plates at the side and under the counting tubes the number of the threefold coincidences is raised. This is explained as scattering of the secondary rays in this metal. By means of a fivefold coincidence arrangement the occurrence of secondary ray groups was proved and their frequency investigated. J. J. S.

3519. Analysis of the Absorption Curve of the Ultra-Radiation. E. Lenz. *Zeits. f. Physik*, 83. 3–4. *pp.* 194–213, *June* 14, 1933.—A method is developed according to which a radiation on the basis of its absorption curve can be analysed in a simple way into its components, with incidence in all directions and with consideration of the scattered radiation. By this method an analysis is carried out of the absorption curve of the cosmic radiation according to the measurements of E. Regener. J. J. S.

3520. Absorption of Ultra-Radiation. B. Gross. *Zeits. f. Physik*, 83. 3–4. *pp.* 214–221, *June* 14, 1933.—A simple relation is given which permits of the determination of the case for vertical coincidence from the experimentally obtained curve of the intensity of a radiation incident on all sides. The method is applied to the absorption curve of the ultra-radiation in the atmosphere. J. J. S.

3521. Aeroplane Cosmic-Ray Intensity Measurements. L. M. Mott-Smith and L. G. Howell. *Phys. Rev.* 44. *pp.* 4–11, *July* 1, 1933.—The following cosmic-ray measurements have been made: (1) day-time intensity curve from 1000 to 27,000 feet, (2) night-time intensity curve up to 27,000 feet, (3) absorption in a few cm. of lead at various elevations, (4) intensity measurement at 27,000 feet during the solar eclipse of August 31, 1932. A change with altitude in the character of the "*übergangs*" effect for cosmic-rays passing from air into lead is shown from the absorption-in-lead curves. Comparison with the earlier high altitude measurements, notably those of Kolhörster, indicates that the present curve is steeper at 27,000 feet so that the marked decrease in the absorption coefficient above 20,000 feet is not observed. No significant decrease in intensity was observed during the night-time observation even at the highest altitudes. In accord with all previous eclipse measurements, no change in intensity was observed during the solar eclipse. The construction and technique of operation of the high-pressure Wulf-type electroscope used in these measurements are described. AUTHORS.

3522. Cosmic Radiation. P. M. S. Blackett. *Roy. Meteorolog. Soc., J.* 59. *pp.* 217–230, *July*, 1933.—A survey of the known facts and a discussion of the chief hypotheses as to the nature and origin of penetrating radiation.

3523. Emission of Slightly Penetrating Radiation from Some Metals. J. Reboul. *Comptes Rendus*, 196. *pp.* 1596–1598, *May* 22, 1933.—The impression produced by zinc on a photographic plate when in contact therewith in the dark, and originally attributed to the action of zinc vapour emitted by the metal [see R. Colson, *Comptes Rendus*, 123. *p.* 49 (1896)], is due to a radiation of unknown character emitted by the zinc which excites atoms in, *e.g.*, air, or carbon, between the zinc and the plate. Similar phenomena appear to be produced by magnesium, cadmium and nickel. C. A. S.

See also Abstracts 3345, 3404, 3470, 3540, 3736.

RADIATION, GENERAL THEORY.

See Abstract 3562.

REFLECTION. REFRACTION AND DISPERSION.

3524. Variation of Phase by Reflection from Very Thin Metallic Films. P. Rouard. *Comptes Rendus*, 196. *pp.* 1592–1594, *May* 22, 1933.—To examine the change of phase on reflection at an air-metal surface one plate of a Perot-Fabry echelon grating was asymmetrically silvered as previously described. The results are almost the inverse of those observed at a glass-metal surface [see Abstract 1875 (1933)]. An advance of phase first occurs to a maximum which then gradually passes to a retardation, which in turn also attains a maximum and then oscillates. The probable explanation is that the film of metal is thin enough to be transparent. C. A. S.

3525. Determination of the Reflective Power of Metals in the Visible and Ultra-Violet Region. K. v. Fragstein. *Ann. d. Physik*, 17. 1. *pp.* 1–21, *May*, 1933.—The reflective power of steels of various compositions are determined spectrophotometrically in the visible region and the results are compared with the values obtained for the reflective power calculated from optical constants. The reflective powers of silver, Hochheim alloy, magnalium, tellurium, tantalum, pyrites and lead sulphide crystals are determined in the ultra-violet by means of a photoelectric cell

method. The reflective power of tellurium decreases rapidly after 3250 Å, but it is not known whether a minimum is reached as in the case of silver.
H. L. B.

3526. Polish on Metals. R. C. French. *Roy. Soc., Proc.* 140. *pp.* 637–652, *June* 1, 1933.—The structures of polished surfaces of copper, silver, gold and chromium were investigated by electron diffraction using kathode rays. The results show that highly polished surfaces are almost amorphous, in confirmation of the Beilby theory. In some cases the distance apart of the atoms in the surface differed appreciably from that in normal crystals. Reasons are given for concluding against Kirchner's view that the polishing was only a levelling of the crystalline surface. Single crystals of copper and chromium were also investigated and the breaking up of the structure under mechanical working was observed. AUTHOR.

3527. Geometrical Optics in Inhomogeneous Media. J. Picht. *Zeits. f. Instrumentenk*, 53. *pp.* 274–282, *June*, 1933.—The results obtained in a previous paper [see Abstract 1196 (1933)] are extended to a higher degree of accuracy. C. B. A.

3528. Studies in Refractive Index. Parts I and II. A. M. Taylor and A. M. Glover. *J.O.S.A.* 23. *pp.* 206–214, *June*, 1933.—In Part I four methods are described for measuring the refractive index of strongly absorbing liquids. The first two of these depend upon determination of the critical angle of reflection of monochromatic light at a glass-liquid interface. In the third, white light was reflected at angles near the critical angle and was then allowed to enter a spectrograph. Microdensitometer records were made of the resulting spectrograms. Peaks in the record correspond to maxima of the refractive index. In the fourth method the transmitted light was examined visually in a spectroscope. In Part II these methods have been applied to a saturated aqueous solution of potassium permanganate. As a result a dispersion curve was found with a strong anomaly around 5473 Å and in addition a series of minor anomalies corresponding to the banded structure of the absorption spectrum. It is concluded that the band at 5473 Å is that caused by the fundamental frequency of an electronic transition in the manganese atom. AUTHORS.

3529. Absorption Bands and Dispersion of Potassium Chloride. P. Wulff. *Zeits. f. phys. Chem.* 21. *Abt.B.* 5–6. *pp.* 353–367, *June*, 1933.—The paper discusses a method of extrapolation to determine the natural frequency involved in the dispersion formula, with particular reference to the effect on the accuracy obtained when the decrement term in the dispersion theory is neglected. Potassium chloride, whose dispersion and absorption curves into the far ultra-violet are known, is investigated on the basis of the classical dispersion theory and on the proposed approximate method and the analysis of theoretical and experimental data shows that the absorption maximum can be determined with sufficient accuracy by extrapolation of the dispersion curve. The ν-value of the maximum obtained with the approximation is about 1 % greater than if an infinitely small absorption band were considered. [See Abstract 2518 (1931) and following Abstract.]
W. D. W.

3530. Dispersion in the Visible and Ultra-Violet. P. Wulff. *Zeits. f. phys. Chem.* 21. *Abt.B.* 5–6. *pp.* 368–381, *June*, 1933.—A graphical representation of the dispersion is discussed in which the reciprocal value of the molecular refraction is plotted against the square of the frequency.

This procedure is used to connect the first ultra-violet absorption band of the anion in crystalline salts with the dispersion curve and to obtain the natural frequency of the uncoupled ions by graphical extrapolation. The angle at which the curve intersects the abscissa is a measure of the transition probability in the first term of the dispersion formula. [See also preceding Abstract.] W. D. W.

3531. Dispersion of Gases and Vapours. Part IV. Dispersion of Mercury Vapour between 2800 and 1890 Å. G. Wolfsohn. *Zeits. f. Physik*, 83. 3–4. *pp.* 234–246, *June* 14, 1933.—In addition to earlier measurements of the dispersion of Hg vapour between 7000 and 2700 Å dispersion measurements have been carried out with a Jamin-Mach interferometer between 2800 and 1890 Å. The dispersion of Hg vapour between 7000 and 1890 Å is represented by a dispersion formula of three members. The duration of life of the Hg $7p^1P_1$ state is found to be $T = 1\cdot30 \times 10^{-9}$. [See Abstracts 128 and 853 (1931).] J. J. S.

3532. Evaporated Films for Large Mirrors. R. C. Williams and G. B. Sabine. *Astrophys. J.* 77. *pp.* 316–320, *June*, 1933.—An apparatus and technique for depositing metallic films upon large mirrors is described. Chromium and aluminium have been found to possess valuable properties of reflectivity and permanence, and to exhibit no tarnish after several months' use in the laboratory. The reflectivity of aluminium has been observed to decrease from 90 % at 6000 Å to 80 % at 3000 Å. Some astronomical advantages of these films are discussed. AUTHORS.

3533. Immersion Microscope Objective for Use with Wave-Length 214 mμ. B. K. Johnson. *Journ. Sci. Instruments*, 10. *pp.* 174–175, *June*, 1933.—The paper gives the complete specification for an immersion microscope objective designed for use with wave-length 214 mμ. Various minor points relating to the use of such an objective in practice are mentioned. AUTHOR.

See also Abstracts 3292, 3302, 3396, 3397, 3491, 3508, 3509, 3560.

SPECTROSCOPY.

3534. Arc Spectra of Chromium, Manganese, Cobalt, and Nickel in the Red and near Infra-Red. H. Slevogt. *Zeits. f. Physik*, 82. 1–2. *pp.* 92–118, *April* 22, *and* 84. 1–2. *p.* 136, *July* 17, 1933.—Using neocyanine and dicyanine sensitised plates the arc spectra of Cr, Mn, Co, and Ni have been investigated between 6000 and 9000 Å. Results are compared with existing data. W. R. A.

3535. First Spark Spectrum of Arsenic. A. S. Rao. *Indian Journ. Phys.* 7. *pp.* 561–584, *April* 20, 1933. *In English.*—By photographing the spectrum of arsenic under varying excitations in the region λ8400 to λ4000, the analysis of the lines of As II previously published [see Abstract 3749 (1932)], has been considerably extended. Higher members of the mp ^3P terms have been identified. Combinations involving the transition of one of the inner group of s^2p^2 electron configuration have also been detected. Interesting cases of interpenetration of the different sub-levels, indicating a strong tendency towards the "JJ" coupling is observed. AUTHOR.

3536. Spectrum of Molybdic Anhydride. G. Piccardi. *Accad. Lincei, Atti.* 17. *pp.* 654–656, *April* 23, 1933.—The Bunsen flame spectrum of molybdic anhydride is continuous from about 6600 to 4840 Å, with two maxima of intensity at 5520 and about 6300 Å. With the oxyhydrogen flame the spectrum is similar although slightly more extended, and without the slightest appearance of bands. The arc spectrum is practically a line spectrum, with a feeble group of bands at 6100–6500 Å. The continuous spectrum must be regarded as due to the molecule MoO_3 and may be considered either as the characteristic spectrum of this molecule in normal conditions of excitation or as a new type of predissociation spectrum due to the emission of the atomic doublet MoO, not yet quite free and hence disturbed by the oxygen atoms still united to it. T. H. P.

3537. H.F. Spectrum of Argon in Presence of Mercury. R. Zouckermann. *Comptes Rendus*, 196. *pp.* 1478–1480, *May* 15, 1933.—When mercury vapour enters an argon discharge tube (wave-length of the circuit 12 m.) the mercury lines appear whilst those of argon at first become feebler and then stronger again; the character of the discharge is, however, different from that in Hg vapour alone under the same conditions. The initial discharge potential falls from 189 to 162 volts when the Hg vapour is admitted, and the steady potential from 20 to 10 volts. The mechanism appears to involve, in the first case, the production of ionised A by secondary collisions of metastable atoms, and in the second case ionisation of the Hg by the metastable A atoms, with consequent diminution of the number of A ions formed. H. F. G.

3538. Spectra Emitted by H.F. and D.C. Discharges in Helium. J. E. Keyston. *Phil. Mag.* 15. *pp.* 1162–1173, *June*, 1933.—Particulars of the line, band and continuous spectra in the visible and ultra-violet regions emitted by discharges in helium at pressures up to 57 mm. are given. J. S. G. T.

3539. Emission of Light from a Gaseous Mixture. W. Uyterhoeven, J. Bruynes and C. Verburg. *Comptes Rendus*, 196. *pp.* 1653–1655, *May* 29, 1933.—The colour of the light emitted by a mixture of gases through which a discharge is passing depends upon the current density. By passing an a.c. the colour varies throughout the cycle and hence, due to the residual image in the eye, new colours may be obtained from the discharge. It is mentioned that an approximately white light may be obtained in this way from certain gas mixtures. J. E. R. C.

3540. Light Emission from Discharge Tubes. H. Krefft, M. Reger and R. Rompe. *Zeits. f. techn. Physik*, 14. 6. *pp.* 242–246, 1933. —Several processes enter into the emission of light from the positive column of a gas discharge. These are investigated for different kinds of lighting tubes. In particular sodium-rare gas mixture tubes are considered. It is found in the case of metals giving doublet spectra that increase of current and vapour density excites higher members of the series and also a continuous spectrum, so that the colour of the discharge is changed. F. S.

3541. Spark Spectrum of BaII. E. Rasmussen. *Zeits. f. Physik*, 83. 5–6. *pp.* 404–411, *June* 20, 1933.—The source used was a hollow carbon kathode in a helium discharge; 57 new combinations and 23 new terms were established. By fixing closer limits the discrepancies of earlier investigations have been resolved. Two fundamental series 3D–mF and 4D–mF and two new combination series 3P–mS and 3P–mD have been arranged. The F terms show anomalous displacement and splitting as in the case of Al II. F. S.

3542. Spectrum of Selenium. Part II. J. S. Badami and K. R. Rao. *Roy. Soc., Proc.* 140. *pp.* 387–398, *May* 3, 1933.—Following the publication of the analysis of the spectra of Se IV and Se V, the spectrum of doubly-ionised Se has been investigated with the aid of the experimental data available in the previous work. The triplet and singlet systems of Se III due to the configurations $4p^2$, $4p5s$, $4p5p$, $4p4d$ and $4s4p^3$, have been discovered, an important feature being the identification of the terms of the last-mentioned state. About 110 lines have entered into the scheme ; besides these, lines belonging to a few triplet groups, expected to lie in the far infra-red, have been calculated. The absolute values of the terms have been determined from two members of a triplet and a singlet series. The largest term, $4p^3P_0=274024$ cm.$^{-1}$, leads to a value of 33·0 volts for the third ionisation potential of selenium. An examination of these term values has shown that there is an interpenetration of the sub-levels of terms belonging to the $4d$ state as well as of those of the $5p$ state, indicating a definite departure from normality even in the relatively simple case of an s^2p^2 electronic system. [For Part I see Abstract 2683 (1931).] E. E. F. d'A.

3543. Alkali Metals in Minerals. R. Bossuet. *Comptes Rendus,* 196. *pp.* 1381–1383, *May* 8, 1933.—This investigation applies the technique of a previous paper [see Abstract 1890 (1933)] for finding the distribution of the alkali metals in minerals. The rare metals are found in association with K and not with Li, Na, or Ca. Rb is found more frequently than caesium, although in pollux, the mineral containing Cs, K is only present in traces. The rare alkali metals appear to be concentrated in the potassium felspars and micas, and the minerals of secondary formation, such as the zeolites, and the sodium and calcium silicates do not contain them. H. H. Ho.

3544. Absolute Value of the Terms of As. W. M. Hicks. *Phil. Mag.* 15. *pp.* 1080–1085, *June,* 1933.—The spectrum of neutral arsenic is re-analysed and it is concluded that the value of $s^4 1=87945$ cm^{-1} as compared with the value 85000 cm^{-1} on which the previous analysis, by Rao [see Abstract 4985 (1932)] was based. C. B. A.

3545. Significance of Colours Produced by Atoms. A. D. Fokker. *Physica,* 13^e. 4. *pp.* 97–115, 1933.—An account in simple terms of the origin and interpretation of the emission spectra of atoms and ions. H. F. G.

3546. Spectrum Analysis. T. L. de Bruin. *Physica,* 13^e. 4. *pp.* 116–138, 1933.—A general description is given of the analysis of emission spectra and the classification of the lines produced by elements and ions. H. F. G.

3547. Fine Structure of Reststrahlen. M. Born and M. Blackman. *Zeits. f. Physik,* 82. 9–10. *pp.* 551–558, *May* 23, 1933.—Secondary maxima in the absorption of reststrahlen by alkali halides have been deduced theoretically assuming as model a unidimensional grating. In this way the position of the maxima is obtained as a function of the mass of the ions. The agreement between observed and calculated values is satisfactory for lithium fluoride, and for sodium and potassium chlorides. W. R. A.

3548. Fine Structure of the Metastable Nitrogen Line 1492·83. W. Tschulanovsky. *Zeits. f. Physik,* 82. 1–2. *pp.* 134–136, *April* 22, 1933.—The doublet 1494 Å was photographed with the new Leningrad vacuum spectrograph having a linear dispersion of 8·4 Å/mm., and a slit of 3·5$m\mu$. The distance between the two components of the line 1492·83 Å on the plate was 0·0235 mm., but the absolute values of the components could not be determined as no standard lines were in the neighbourhood. The splitting of the terms 2D5*s*/2, 3/2 was made on the basis of the doublet scheme and the well-known splitting $2s^2 2p^2 3s^2$P3/2, ½. Its value was 8·9 cm.$^{-1}$. The doublet 1745 Å could not be split up with the apparatus. E. E. F. d'A.

3549. Absence of Fine Structure in the Arc Spectrum of Silver. S. Tolansky. *Phys. Soc., Proc.* 45. *pp.* 559–564, *July* 1, 1933.—The arc spectrum of silver, produced in a water-cooled hollow-kathode discharge, has been examined for fine structure with a variable-gap silvered Fabry-Perot interferometer in the region 8300 to 4000 Å. Results for the resonance lines at approximately 3300 Å are also quoted. Silver consists of two odd isotopes 107, 109, and although 5*s*, 6*s*, 7*s*, 5*p*, 6*p*, and 5*d* terms have been studied no trace of fine structure has been found, in spite of very excessive over-exposing in many lines. All lines are extremely sharp and are worth considering as wave-length standards, being well distributed. Attention is drawn to the fact that the analogous spectrum of CdII also shows no fine structure, so that it is concluded that the absence of structure is probably due to the electron configuration and not necessarily to smallness of the nuclear magnetic moment. This is remarkable, for penetrating *s* electrons are involved in some configurations. AUTHOR.

3550. Intensity Measurements on the Principal Series Terms of Rubidium and Caesium. H. Kohn and H. J. Hübner. *Phys. Zeits.* 34. *pp.* 278–282, *April* 1, 1933.—Intensity measurements were made on the 6^2P–5^2S and 7^2P–5^2S doublets of Rb and on the 8^2P–6^2S doublet of Cs—the values being respectively 2·57, 3·23, and 8·00 for an "infinitely thin" layer. Experimental results are compared with values calculated (1) according to the Burger-Dorgelo intensity rule, (2) from Roschdestwenski's dispersion measurements, and (3) from Fermi's quantum-mechanical formula. Progressive deviation from each of these calculated values is encountered. W. R. A.

3551. Light Yield Measurements in the Sodium Spectrum by Excitation by Means of Electron Bombardment. G. Haft. *Zeits. f. Physik,* 82. 1–2. *pp.* 73–91, *April* 22, 1933. *Phys. Zeits.* 34. *pp.* 287–288, *April* 1, 1933.—The excitation functions of the secondary series and of the *D* lines of Na have been measured between 2 and 200 volts. Ascertained data have been compared with previous measurements on singlet-triplet term systems, and the validity of the observed regularity of the dependence of the excitation function on the initial term has been satisfied, also for the doublet system. The relative intensity of the Na lines has also been measured. By means of a combination of a method of magnetic deflection with the double field method it has been possible to obtain information regarding the ultimate breadth of the excitation function maximum. W. R. A.

3552. Intensity of Spectral Lines in the Glow Discharge of the So-called Multi-Coloured (Bunt) Hydrogen. A. Güntherschulze and H. Betz. *Zeits. f. Physik,* 83. 3–4. *pp.* 152–163, *June* 14, 1933.—

The intensities of spectral lines in the glow discharge in very thoroughly dried hydrogen saturated with mercury vapour at room-temperature are determined. Drying does not affect very considerably either the multiline spectrum of hydrogen or the mercury yellow lines 5790 and 5770. The intensity of H_α in the first kathode space with a kathode fall of potential about 330 V is increased 7-fold on account of drying; the effect is attributable to protons present in the region of the kathode. Under similar conditions the intensity of the mercury green line 5461 is increased about 48-fold owing to drying. The two other lines of the triplet appear to behave in a similar manner. In the anode glow and the hydrogen striations the intensities are quite differently affected. The mercury lines are not particularly developed; the effect of drying is to reduce the intensity of the green line 5461 in these regions. With mercury vapour present at even so small a pressure as 2×10^{-6} Tor in multi-coloured hydrogen under a pressure of 1·83 Tor, the green line 5461 is by far the brightest line of the whole spectrum. J. S. G. T.

3553. Relation between the Intensities of Balmer and Paschen Lines. L. S. Ornstein and H. C. Burger. *Zeits. f. Physik*, 83. 3–4. *pp*. 177–178, *June* 14, 1933.—The previously published value 2·6 for the intensity ratio H_β/P_α [see Abstract 3729 (1930)] is confirmed by new measurements at pressures between 0·2 and 0·02 mm. Hg, using an "end-on" tube similar to that employed in the earlier determinations. When, however, a kind of Geissler tube with capillary is used as source, a different value (namely, $H_\beta/P_\alpha = 2{\cdot}2_5$) is obtained at pressures ranging from 0·9 to 0·03 mm. Hg. L. A. W.

3554. Isotope Displacement Effect. H. Schüler and H. Westmeyer. *Zeits. f. Physik*, 82. 11–12. *pp*. 685–689, *May* 30, 1933.—With the help of hyperfine structure investigations the $d^9s^2m^2D_{\frac{3}{2},\frac{5}{2}}$ terms of Cd II are established. Isotope displacements appear in lines which represent transitions to or from these terms. Comparison of the corresponding displacements of Cd I, Zn II, Cd II and Hg II shows that between Zn II and Cd II a change in the direction of the displacement takes place; the heaviest isotopes have the largest term values in the case of Cd I and Zn II and the smallest term values in the case of Cd II and Hg II. The complete hyperfine structure of 3261 Å of Cd I is given. J. E. K.

3555. Hyperfine Structure. H. Schüler and H. Westmeyer. *Zeits. f. Physik*, 83. 3–4. *pp*. 270–276, *June* 14, 1933.—Certain statements are discussed which have appeared in recent publications on hyperfine structure. (*a*) It is maintained that some of the components attributed to 4916 Å of Hg I by B. Venkatesachar are in reality ghosts arising from the quartz Lummer plate. (*b*) The view taken by Paschen, that the anomalous splitting of the 6^1D_2 term of Hg I is not due to a resonance effect, but to a magnetic transformation of the levels, has no theoretical support. (*c*) The correctness of the isotope displacements in the Tl I spectrum as given by Schüler and Keyston is questioned by Breit on theoretical grounds. The observations are not in doubt and have been confirmed by Jackson. (*d*) The isotope displacements in the copper spectrum observed by Ritschl can be allocated to the levels in another way which seems to remove certain anomalies. In a reply to statement (*a*) above **B. Venkatesachar** points out that Schüler and Westmeyer have not conclusively shown that the components of 4916 Å of Hg I which he observed were Lummer plate ghosts. J. E. K.

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3556. Theory of Hyperfine Structure. E. Fermi and E. Segrè. *Zeits. f. Physik*, 82. 11–12. *pp.* 729–749. *May* 30, 1933.—A theoretical investigation is made of the results of experimental hyperfine structure analysis of lines of the elements Li, Na, Cu, Ga, Rb, Cd, In, Cs, Ba, Au, Tl, Pb and Bi. It is found that the assumption of a magnetic nuclear moment does not in any case lead to conflict with experimental results if one takes account of the numerous perturbing effects, including those between different electron configurations. This assumption suffices to give a general interpretation of all the observations, but the possibility that other nuclear properties produce small disturbances is not entirely excluded. The conclusions which may be drawn from experimental results concerning the magnitude of the magnetic moment of the nucleus are finally discussed. J. E. K.

3557. Hyperfine Structure and the Polarisation of Resonance Radiation. Part II. Magnetic Depolarisation and the Determination of Mean Lives. A. C. G. Mitchell. *Phys. Rev.* 43. *pp.* 887–893, *June* 1, 1933.—Breit has derived formulæ giving the polarisation P(H) and the angle of maximum polarisation θ of a resonance line showing hyperfine structure, as a function of a weak magnetic field applied in the direction of observation of the resonance radiation. The formulæ give a means of estimating the effect of hyperfine structure on the calculation of the mean life τ of an excited atom from experiments on the magnetic depolarisation and rotation of the plane of polarisation of resonance radiation. The calculation has been carried through for the case of the resonance line of Cd(λ3261) and that of Hg(λ2537), and it is found that the differences between the value of τ calculated from hyperfine structure data and that calculated from tan 2θ by the usual non-hyperfine structure method lie well within the experimental error. $P(H)/P_0$ is found to be practically the same whether hyperfine structure is taken into account or neglected. This is due to the fact that the greatest contribution of the polarisation in these cases comes from the isotopes having no nuclear spin and the *g*-value for the upper state of these isotopes is larger than any other upper hyperfine structure state involved. The mean lives of the 7^3S_1 state of mercury have been recalculated from Richter's data on the polarisation of stepwise radiation. The value of τ obtained by this method of calculation are $7 \cdot 2 \times 10^{-9}$ for λ4047, $1 \cdot 69 \times 10^{-8}$ for λ4358 and $1 \cdot 53 \times 10^{-8}$ for λ5461. A discussion of Richter's results is given. [For Part I see Abstract 4321 (1932).] AUTHOR.

3558. Anomalies in Hyperfine Structure. S. Goudsmit and R. F. Bacher. *Phys. Rev.* 43. *pp.* 894–899, *June* 1, 1933.—The deviations from the interval rule in the hyperfine structure of two of the energy states in mercury can be explained satisfactorily as due to perturbations arising from their proximity. The forbidden line Hg I $\lambda 2967 \cdot 5$ ($6s\ 6d\,{}^1D_2$–$6s\ 7p\,{}^3P_0$) and its hyperfine structure are also explained by these perturbations. The hyperfine structure ascribed to the $3s\ 4f$ levels of ionised aluminium which has seemed to be in contradiction with the theory, can be shown to belong partially to the $3s$ ng levels and to come out in agreement with theoretical expectations. AUTHORS.

3559. Hyperfine Structure of Perturbed Series. E. G. Jones. *Phys. Soc., Proc.* 45. *pp.* 501–506, *July* 1, 1933.—A discussion of the hyperfine structures of the terms in perturbed series is given, and rules governing such effects are derived. It is found that these rules are not analogous to those obtained from the analysis of multiplet structures. AUTHOR.

3560. Dispersion of Light in the Neighbourhood of Quadripole Lines. J. Blaton. *Zeits. f. Physik,* 82. 9–10. *p.* 684, *May* 23, 1933.—Correction is made of an error which occurred in an equation given in the author's paper on this subject [see Abstract 2442 (1932)]. After the correction in the dispersion formula the agreement between theory and experiment still remains good. J. J. S.

3561. Dissociation of Excited Diatomic Molecules by External Perturbations. C. Zener. *Roy. Soc., Proc.* 140. *pp.* 660–668, *June* 1, 1933.—The mathematical theory of inducing transitions by external perturbations between crossing attractive and repulsive states of different states is discussed. The results are of interest when the vibrational energy of the molecule is less than the potential energy at the point of crossing. The transitional probability is then equal to the product of an electronic transition probability and the probability that the nuclei pass through a potential barrier. Electric fields of 20,000 volts/cm. have a marked dissociative effect upon excited states crossed by appropriate repulsive states. All types of transitions are readily induced by collisions. J. S. G. T.

3562. Oscillation Structure of Electron-Transfer in Polyatomic Molecules. G. Herzberg and E. Teller. *Zeits. f. phys. Chem.* 21. *Abt.B.* 5–6. *pp.* 410–446, *June,* 1933.—The selection rules are discussed for the oscillation quantum numbers, during electron transfer in polyatomic molecules. The application of the Franck-Condon principle gives as a first approximation that in the absorption from the fundamental state (absence of oscillation) the intensive bands which occur are those excited by totally symmetrical oscillations, and the following rule is derived, *viz.,* the transformation characteristics of the oscillation eigenfunctions of the initial and final states must be the same. This rule is based on the assumption that the probability of electron transfer is independent of the nuclear position, but in many cases the latter plays an essential rôle, since in polyatomic molecules the symmetry properties may be changed by nuclear displacements, and thereby transfers are possible which are excluded by molecular symmetry. The conditions for the latter transfers are briefly discussed, and examples (especially with methyl iodide) are included. H. H. Ho.

3563. Applicability of the Franck-Condon Rule to Line Broadening. W. Lenz. *Zeits. f. Physik,* 83. 3–4. *pp.* 139–142, *June* 14, 1933.—It is proved that the applicability of the Franck-Condon rule to the broadening of spectral lines by foreign gases is limited to cases where the pressure of the foreign gas exceeds about 100 atmospheres. J. E. K.

3564. Primed (Two-Electron) Terms of the Alkali-Earth Spectra. H. C. Brinkman. *Zeits. f. Physik,* 83. 3–4. *pp.* 259–265, *June* 14, 1933.—Theoretical considerations show that the terms in the spectra of Ca, Sr and Ba, which were denoted as *x*-terms by Russell & Saunders, are *pd* ^{1}D terms. The probable positions of the ^{1}P and ^{1}F terms, belonging to the same electron configuration, are estimated. J. E. K.

3565. Near Infra-Red Band System of Strontium Oxide. K. Mahla. *Zeits. f. Physik,* 81. 9–10. *pp.* 625–646, *April* 7, 1933.—Details are given of the system and of the fine structure of three bands at 7882, 8257, and 8700 Å. The system arises from a $^1\Sigma$–$^1\Sigma$ transition. In the

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upper state the moment of inertia is $82 \cdot 1 \times 10^{-40}$ gm.cm^2., and the nuclear separation $1 \cdot 92 \times 10^{-8}$ cm., whilst in the lower state the values are $74 \cdot 1 \times 10^{-40}$ gm.cm.^{2} and $1 \cdot 82 \times 10^{-8}$ cm., respectively. H. F. G.

3566. Long-Wave Arc Spectra of Alkalies and Alkaline Earths. W. F. Meggers. *Bureau of Standards, J. of Research*, 10. *pp.* 669–684, *May*, 1933.—New types of photographic plates sensitive to red and infra-red radiation are employed to record the emission spectra of electric arcs containing alkalies or alkaline earths. Several lines characteristic of sodium, potassium, rubidium, and cæsium are observed in the interval 8,500 to 11,800 Å. A larger number of lines are measured in calcium, strontium and barium spectra between the limits 6500 and 11,300 Å. Practically all of the observed lines are accounted for as combinations of identified spectral terms. A new system of band heads, presumably due to CaO, was found in the infra-red. AUTHOR.

3567. Investigations in the Infra-Red Region of the Spectrum. Part VIII. Application of the Grating Spectrometer to Certain Bands in the Spectra of Triatomic Molecules. C. R. Bailey and A. B. D. Cassie. *Roy. Soc., Proc.* 140. *pp.* 605–612, *June* 1, 1933.—The sulphur dioxide bands at $4 \cdot 01$ and $4 \cdot 37\mu$ have been examined with a grating spectrometer, and the presence of a previously unrecognised Q branch in the former makes it certain that the molecule is triangular, with a vertical angle of 120°. Apparent contradictions between the selection rules for the Raman and infra-red spectra are thus removed. The carbon disulphide band at $4 \cdot 61\mu$, when explored with the grating instrument, confirms the previously determined separation for the P. and R. branches. The molecular structure of the above substances is discussed. [For Part VII see Abstract 1088 (1933).] AUTHORS.

3568. Spectrum of Carbon Dioxide. G. P. Ittmann. *Physica*, 13*e*. 6. *pp.* 177–188, 1933.—A survey is given of the theory of the infra-red and Raman spectra of carbon dioxide. The significance of the accidental degeneracy between one of the fundamental vibrational frequencies of this molecule and the first harmonic of another one is discussed. [See Abstract 455 (1932)]. AUTHOR.

3569. Rotation-Vibration Spectrum of Ethylene in the Near Ultra-Violet. W. Scheib and P. Lueg. *Zeits. f. Physik*, 81. 11–12. *pp.* 764–770, *April* 18, 1933.—The rotation-vibration bands of ethylene at 8715 Å have been examined under high dispersion ($2 \cdot 6$ Å/mm.). The mean moment of inertia of the molecule is $28 \cdot 85 \times 10^{-40}$ gm.cm.^{2}., and the distances C — H and C = C are $1 \cdot 08 \times 10^{-8}$ cm., and $1 \cdot 34 \times 10^{-8}$ cm., respectively. The value for the C = C separation agrees closely with that calculated from the deflection of electrons passing through a stream of ethylene gas. The coordination of the bands with one of the known vibration types is discussed. H. F. G.

3570. Fine Structure of the Ultra-Violet Bands of Carbon Disulphide. A. Jonescu. *Comptes Rendus*, 196. *pp.* 1476–1478, *May* 15, 1933.—The bands in the neighbourhood of 3000 Å exhibit three different types of structure, *viz.*, parallel bands with P branches only, parallel bands with P and R branches, and perpendicular branches. The angle formed by the carbon atoms and the sulphur atom is 119°48′ in the case of the normal molecule, and 96°22′ in the excited state. The three principal moments of inertia are $1 \cdot 23$, $7 \cdot 32$, and $8 \cdot 55 \times 10^{39}$gm./cm.^{2} for the normal molecule, and $2\cdot17$, $5\cdot45$, and $7\cdot62\times10^{39}$gm./cm.^{2}, respectively, for the excited molecule. H. F. G.

3571. Spectrum of OH Molecule: New (2,2) Band; Satellite Series in λ3122; Λ-Type Doubling and Electronic Spin Doubling. D. H. Dawson and H. L. Johnston. *Phys. Rev.* 43. *pp.* 980–991, *June* 15, 1933.—The investigations begun in the neighbourhood of the $(0',1'')$ band at λ3428 have been extended to include the bands of the (0,0) and $(1',0'')$ sequences. Approximately 400 lines were observed in this region of the spectrum, of which 120 are reported for the first time. All but 18 of these have been successfully assigned. The assignments include the identification of a new (2,2) band with its principal head at λ3185; the identification of ${}^{RR}R_{21}$ and of ${}^{PP}P_{12}$ satellite branches of the (1,1) band; complete assignments of the regular R-branches of the (1,1) and $(2',1'')$ bands; and extensions of nearly all the remaining branches of the bands which appear in this region. The new data are also utilised to obtain Λ-doublets and spin doublets to $K=35$ for the $0''$ level and to somewhat smaller values of K for the $1''$ and $2''$ levels. The experimental results are compared with equations in the literature. Molecular constants derived from the new (2,2) band are in good agreement with those derived from the $(1',2'')$ band. AUTHORS.

3572. Infra-Red Absorption Measurements on Organic Substances. Part I. Apparatus and the Absorption Spectra of Solvents and Organic Dyes. G. Buss. *Zeits. f. Physik*, 82. 7–8. *pp.* 445–460, *May* 15, 1933.—A new mirror spectrometer is described. The angle of rotation is measured by a micrometer screw. Possible sources of errors are discussed and the magnitudes of errors indicated. Absorption measurements between $0\cdot8$ and $2\cdot4\mu$ have been made on benzene, water, ethyl, alcohol and glycerin and obtained bands checked up against existing data. Sixteen dyestuffs, belonging to azo, phthalein, triphenylmethane, or acridine groups of dyes, were investigated within the same spectral range. Most of the dyes were investigated both in solution and in a solid film. W. R. A.

3573. Infra-Red Absorption Measurements on Organic Substances. Part II. Absorption of Certain Organic Liquids below $2\cdot7\mu$. O. Eichmann. *Zeits. f. Physik*, 82. 7–8. *pp.* 461–472, *May* 15, 1933.—Using the quartz prism spectrometer previously described [see preceding Abstract] the infra-red absorption spectra between $0\cdot8$ and $2\cdot6\mu$ have been investigated for benzyl chloride, methyl salicylate, ethyl benzoate, anethole, paraldehyde, *l*- and *d*- pinene, amyl alcohol, amyl nitrite, propionic acid, and ethyl oxalate. Observed data are compared, where possible, with existing data and the assignment of the bands to characteristic groups is discussed. W. R. A.

3574. Infra-Red Absorption Bands of Acetylene. G. B. B. M. Sutherland. *Phys. Rev.* 43. *pp.* 883–886, *June* 1, 1933.—The present interpretations of the overtone bands in the infra-red spectrum of acetylene are unsatisfactory in that they either do not fulfil the known selection rules or else fail to give satisfactory numerical agreement between calculated and observed band positions. A new arrangement of the complete infra-red spectrum of acetylene is given which is in accord with the selection rules and yields consistent numerical results. Several of the anharmonic and interaction constants are thus determined for the five fundamental frequencies. It is remarked that there is probably a direct connection between the magnitudes of these anharmonic constants and the intensities of the overtone bands. AUTHOR.

3575. Infra-Red Absorption of Benzene in the Liquid, Solid and Vapour States. C. E. Leberknight. *Phys. Rev.* 43. *pp.* 967–972, *June* 15, 1933.—The 2·19μ, 2·46μ, and 3·25μ infra-red absorption regions of benzene were investigated in the liquid, solid and vapour states with a grating spectrograph whose theoretical resolving power was almost 15,000. For all the bands measured the solid absorption was approximately the same as that of the liquid but with the bands shifted slightly towards longer wave-lengths; the 3·25μ and 2·46μ bands showed a shift of about 13 Å, and the bands lying in the 2.19μ region showed a shift of about 20 Å. In the vapour the absorption was quite different from that of the liquid. The 3·25μ region had two strong bands in the vapour, each showing evidences of three components, while the liquid had three bands; interpreting the three components of the vapour bands as the envelopes of the vibration-rotation bands the value, 14×10^{-39} gm.cm.^{2}, is obtained for the moment of inertia of the benzene molecule. The 2·46μ region showed a doublet in the vapour while the liquid had a single strong band. The 2·19μ region showed two bands incompletely resolved in the vapour, but the liquid and solid showed a group of five bands with indications of a sixth. AUTHOR.

3576. Infra-Red Absorption Spectra of NO_2 and N_2O_4. R. Schaffert. *J. Chem. Phys.* 1. *pp.* 507–511, *July*, 1933.—The infra-red absorption spectrum of nitrogen peroxide has been investigated in the gaseous and liquid states, by using a prism spectrometer. Absorption bands were observed at 3·3μ, 3·89μ, 5·7μ, 6·14μ, 7·28μ, 7·85μ, 13·3μ and 15·6μ in the gaseous state, and at 3·65μ and 5·7μ in the liquid state. By heating the gas to a temperature of 150° C., it was found that the bands at 3·89μ, 5·7μ, 7·85μ and 13·3μ were due to N_2O_4, while those at 3·3μ, 6·14μ, 7·28μ and 15·6μ were due to NO_2. AUTHOR.

3577. Absorption of Ultra-Violet Light by Organic Substances. W. Gabryelski and L. Marchlewski. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3A. *pp.* 87–94, *Jan.–March*, 1933. *In English.*—A sector photometer is used in this work, the source of light being a spark between tungsten steel electrodes. The absorption of several carbohydrates is determined, the substances studied being cellobiose, rafinose, acetylcellobiose, β-acetyl-lactobiose, acetyl saccharose and acetyl maltose. A. H.

3578. Absorption of Ultra-Violet Light by Organic Substances. L. Marchlewski and T. Surzycki. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3A. *pp.* 95–98, *Jan.–March*, 1933. *In English.*—A study is made of the absorption spectra of some pyridine derivatives, these being the isomeric di-ethyl amides of pyridine carbonic acid. A. H.

3579. Absorption of Excited Mercury Vapour. O. Masaki. *Hiroshima Journ. Sci.* 3. *pp.* 187–193, *March*, 1933. *In German.*—Previous work on the effect of temperature on the absorption of excited mercury vapour [see Abstract 2405 (1933)] dealt only with lines corresponding to initial $2^3P_{0,1,2}$ states and final 2^3S_1 states. The work is now extended to other lines in the region 7000–2300 Å, lines of different series showing varying behaviour. F. S.

3580. Significance of Ultra-Violet Absorption Bands of Alkali Halides. W. Klemm. *Zeits. f. Physik*, 82. 7–8. *pp.* 529–537, *May* 15, 1933.—The influence of partial ion-polarisation on the calculation of the frequencies of the ultra-violet absorption bands of alkali halides is discussed. The results are compatible with the assumption that the absorption process takes place inside the lattice. Comments by **M. Born** and **E. Fuess.** C. B. A.

3581. Ultra-Violet Absorption of Benzene Derivatives. Part II. K. L. Wolf and O. Strasser. *Zeits. f. phys. Chem.* 21. *Abt.B.* 5–6. *pp.* 389–409, *June*, 1933.—This paper continues previous work [see Abstract 4187 (1931)] and records ultra-violet absorption measurements for the following di- and tri- substituted derivatives of benzene: benzonitrile; benzoisonitrile; *o*-, *m*-, and *p*-tolunitrile; *o*- and *p*- toluisonitrile; *o*- *m*- and *p*-chlorobenzonitrile; *p*-chlorobenzoisonitrile; *p*-bromobenzonitrile; *o*-, *m*- and *p*-nitrobenzonitrile; the 6 xylenols; 1 : 4 : 2- and 1 : 3 : 4-xylidines; 2-chloro-1 : 4-xylene; 4-chloro- 1 : 3-xylene; pseudocuminol; mesitylene; and 1 : 2 : 4 trichlorobenzene. These data are discussed from the standpoint of the influence of substituents on absorption, and, in the case of the nitriles and isonitriles, dipole-moment measurements are also recorded. The Raman frequencies are included for benzonitrile and the magnitudes of the nuclear oscillations for a series of other substances are deduced. H. H. Ho.

3582. Ultra-Violet Absorption Spectrum of Oxygen. L. Herman. *Comptes Rendus*, 196. *pp.* 1877–1880, *June* 19, 1933.—Using a larger dispersion the author has obtained a much more complete study of the absorption of oxygen in the ultra-violet than that described by Finkelnburg and Steiner [see Abstract 608 (1933)]. The spectrum contains a family of vibration-rotation bands whose number corresponds to that of large triplets. The moment of inertia of the absorbing molecule is deduced as $0\cdot9 \times 10^{-40}$ gm.cm.^{2} and therefore this molecule cannot be O_2 ($2\cdot2 \times 10^{-39}$ gm.cm.^{2}). This evidence therefore supports the belief in the existence of a molecule O_4. H. H. Ho.

3583. Symmetrical Vibrations. A. D. Fokker. *Physica*, 13*e*. 3. *pp.* 65–76, 1933.—The possible types of vibration in the molecules of carbon dioxide, ammonia, and methane, and in crystals of calcite and quartz, are discussed in relation to the classification of vibrations in symmetrical arrangements. H. F. G.

3584. Luminous Reduction of Selenium Dioxide. H. J. Emeléus and H. L. Riley. *Roy. Soc., Proc.* 140. *pp.* 378–387, *May* 3, 1933.—Selenium dioxide vapour will react with methyl-, ethyl-, and propyl-alcohols, acetone, acetaldehyde, ether, ethylene, benzene, toluene, ammonia, hydrogen sulphide, and carbon disulphide at about 400° C., giving a bright blue flame. The principal oxidation products are oxides of carbon, carbon, and water from the carbon compounds; nitrogen and water from ammonia; and sulphur dioxide, sulphur and oxides of carbon from carbon disulphide. All of the flames have the same spectrum, consisting of bands and continuous radiation between 5700–3600 Å; the band systems being attributed to the Se_2 molecule, and possibly also to the oxide of selenium. The same bands occur in the flame of selenium in oxygen, which also shows emission bands attributed to SeO_2. None of the flames has an ultra-violet spectrum. These flame spectra are totally different from those of the corresponding flames in oxygen. A phosphorescent flame has been obtained by heating selenium dioxide in an ammonia stream at 100°–300° C. Its spectrum has been photographed, and is the same as that of the hot flame of ammonia burning in selenium dioxide. E. E. F. d'A.

3585. Band-Spectra of Diatomic Molecules. W. Jevons. *Phys. Soc. Report,* [308 *pp.*], 1932.

3586. Interpretation of the Mercury-Argon Bands at 2365 and 2285 Å and of the Hg_2 Band at 1690 Å. W. Finkelnburg. *Zeits. f. Physik,* 81. 11–12. *pp.* 781–784, *April* 18, 1933.—If it is assumed that a normal A atom and a 2^3P_2 Hg atom combine, then the unexplained Hg-A bands found by Kessel [see Abstract 3815 (1931)] at 2365 and 2285 Å can be interpreted as resulting from a $3^3P_2 \rightarrow 1^1S$ transition, forbidden in the Hg spectrum. A similar interpretation has been given for the Hg_2 band at 1690 Å, the Zn_2 band at 2002 Å, and the Cd_2 band at 2112 Å. W. R. A.

3587. Infra-Red Energy Levels of the H_2O Molecule. K. Basu. *Indian Phys. Math. J.* 4. *pp.* 21–27, *April,* 1933. *In English.*—Assuming a triangular model for the water molecule the band spectrum given by such a molecule is discussed in terms of Schrödinger mechanics. A. H.

3588. Band Spectra and Molecular Structure. Part I. W. Weizel. *Phys. Zeits.* 34. *pp.* 425–440, *June* 1, 1933.—This review of work in the last two years is intended to bring the subject up to date. Diatomic molecules are dealt with in the present contribution and a Bibliography of 164 references is appended. F. S.

3589. Predissociation and the Crossing of Molecular Potential Energy Curves. O. K. Rice. *J. Chem. Phys.* 1. *pp.* 375–389, *June,* 1933. —The calculation of the width and shape of a line which is broadened because of predissociation has been extended so as to include perturbations of intermediate size. By " perturbations of intermediate size " we mean perturbations which are not so great that lines (of given rotational quantum number) belonging to two adjacent vibrational levels are broadened so as to overlap appreciably ; they may be any size up to that limit. These calculations have been applied with certain simplifying assumptions to the case where a potential curve giving molecule formation is intersected by a repulsive curve, the curves which cross defining the unperturbed energy levels and wave functions. It is found that the discrete lines are not only broadened, but they are shifted in position, slightly distorted in shape, and there is present a series of subsidiary maxima of the absorption coefficient. The exact amount of broadening of a line depends very greatly upon its energy relative to the energy at which the potential curves cross, and in general a line which is much broadened will also be much shifted in position. In molecules we may expect to have isolated groups of rotational levels in which the central level is sharp, and the rotational levels on either side become more and more diffuse, finally fading out. The predissociation phenomena in iodine chloride are discussed on the basis of the above theory. In particular, two groups of sharp and diffuse levels, such as described, are considered and are respectively ascribed to the isotopic molecules, ICl^{35} and ICl^{37}. There is some difficulty in describing the phenomena in iodine chloride quantitatively, but qualitatively the experimental results appear to accord with the theory. AUTHOR.

3590. Intensity Variations in Fluorescence Series of Sodium. W. G. Brown. *Zeits. f. Physik,* 82. 11–12. *pp.* 768–775, *May* 30, 1933.—Fluorescence series of Na_2 excited by the cadmium lines 4800 and 5086 Å are photographed and the intensities of the lines of two of them are determined from the blackening (accuracy about 15 %) with the help of comparison marks recorded through a step wedge. The observed intensities are compared with the theoretical values obtained from Hutchisson's formula for the linear oscillator, partial correction for anharmonicity being made by inserting in the formula the constants proper to each vibrational level. The good qualitative agreement which is obtained between experiment and calculation provides evidence for the correctness of the Franck-Condon theory of the intensity variations in series of the kind investigated. L. A. W.

3591. Fluorescent Spectra and Chemical Structure of Napthalene Derivatives. A. J. Allen, Rachel Franklin and Ellice McDonald. —*Frank. Inst.*, J. 215, *pp.* 705–722, *June*, 1933.—Each substance studied appears to have a fluorescent spectrum which is characteristic in intensity and distribution. From density curves of the photograms, correlations are established between the spectra and the chemical constitution. These relations are qualitative. The nature of the spectra is independent of the mode of excitation. J. E.

3592. Excitation Function of the Hg Resonance Line, 2537 Å. L. S. Ornstein, H. Lindeman and J. Oldeman. *Zeits. f. Physik*, 83. 3–4. *pp.* 171–176, *June* 14, 1933.—The emission of a line through electron impact is conditioned by three processes: (1) By direct raising of the energy level to the emission level from a lower energy state; (2) by transition from a higher level to the emission level (cascade jump); (3) by ionisation and subsequent union of electron with ion. The intensity of the resonance line has been measured for various speeds of electrons from 5 volts to 130 volts and also similar measurements were made for the other lines—3131, 3125, 4078 and 4358 which are derived by jumps from higher levels to the initial level 2 P of 2537. Subtracting the sum of the ordinates of these curves from those of the 2537 curve there is obtained the excitation curve for 2537 corrected for cascade jumps. It is seen that this corrected curve does not fall steadily after the maximum is reached but rises again twice. These rises are accounted for by reunion of electrons with ions, the electron going to the initial energy level. J. E.

3593. Frequency Distribution of Resonance Radiation. R. W. Ditchburn. *Roy. Irish Acad., Proc.* 41. *pp.* 41–46, *May*, 1933.—Discusses the question raised by Korff [see Abstract 4971 (1932)] as to whether an atom excited by radiation not quite equal to its own resonance emits the exciting frequency or its own resonance frequency. The argument for the effect of the exciting light on the frequency distribution of the emitted light cannot be adequately summarised. J. E.

3594. Zeeman Effect in the Arc Spectrum of Nickel. H. H. Marvin and A. E. Baragar. *Phys. Rev.* 43. *pp.* 973–979, *June* 15, 1933. —Measurements of the Zeeman patterns for 113 lines between λ5500 and λ3000 are presented, from which *g*-factors for 61 terms are calculated. The *g*-sum rule holds for configuration d^9s and for $d^8s(^2F)\cdot 4p$, but not for $d^9\cdot 4p$ or $d^8s(^4F)\cdot 5s$. It does hold for $d^9\cdot 4p$ and the quintet terms of $d^8s(^4F)\cdot 4p$ taken together, indicating that these groups interact. It is surmised that $d^8s(^4F)\cdot 5s$ is perturbed by $d^9\cdot 4d$. The theory of two-electron systems fits d^9s very well. It works fairly well with d^8s^2, but breaks down when applied to $d^9\cdot 4p$, probably because of increased importance of the magnetic interactions which are neglected in the theory. AUTHORS.

3595. Stark Effect in Krypton. N. Ryde. *Zeits. f. Physik*, 83. 5–6. *pp.* 354–370, *June* 20, 1933.—Lo Surdo's method was employed and fields up to 125kV/cm. used. In the region investigated, 6500 Å to 3900 Å, it was found that arc lines are affected but not spark lines. Comparison is made with the behaviour of lines of Ne and A. F. S.

3596. Intensity Relations in the Raman Spectrum of Hydrogen. Part II. S. Bhagavantam. *Indian Journ. Phys.* 7. *pp.* 549–559, *April* 20, 1933. *In English.*—An accurate determination is made of the intensity and polarisation characters of the various lines in the Raman spectrum of hydrogen gas. All the rotation lines are depolarised to the same extent, the value of ρ in each case being $0{\cdot}85 \pm 0{\cdot}05$. Their relative intensities are in good agreement with the conclusions of the quantum theory of the Raman effect developed by Manneback. The depolarisation of the vibration line $n : 0 \rightarrow 1$; $K : 1 \rightarrow 1$ is $0{\cdot}13$ and its intensity, expressed as a fraction of that of the corresponding Rayleigh line, is $2{\cdot}7 \times 10^{-3}$. The discrepancy, already reported in an earlier paper, between the experimental results and the conclusions of the theory in respect of the relative intensities of the Q and R branches of the vibration scattering has been confirmed. A preliminary investigation of the state of polarisation of the individual components of the Q branch shows that the line arising from molecules in the zero rotation state is depolarised to a certain extent. This result is not in agreement with the theory and has to be regarded as a further discrepancy. [For Part I see Abstract 3766 (1932).] AUTHOR.

3597. Raman Spectrum of Water Vapour. D. H. Rank. *J. Chem. Phys.* 1. *pp.* 504–506, *July*, 1933.—The Raman spectrum of water vapour at atmospheric pressure was obtained. Special precautions were taken to avoid parasitic light and a search made for the 1648 cm.$^{-1}$, and 984 cm.$^{-1}$ shifts reported by Johnston and Walker. These shifts were not observed. A line was found which might be correlated with Mecke's $\nu(\sigma)$ but the evidence in this case is not conclusive. AUTHOR.

3598. New Raman Bands of Water. G. Bolla. *N. Cimento*, 10. *pp.* 101–107, *March*, 1933.—Investigation of the Raman spectrum of water at 17° C. excited by the Hg line 2537 Å. of a cold lamp shows that, besides the bands 3200, 3435 and 3630 cm.$^{-1}$, and those in immediate proximity to the exciting line, 60 and 172 cm.$^{-1}$, five other bands may be identified with maximum intensities corresponding with the following values of $\Delta\nu$: 510, 780, 1645, 2150 and 3990 cm.$^{-1}$. All these bands, some of which have been seen or presumed by other workers, have intensities low in comparison with those of the two bands, 3200 and 3435 cm.$^{-1}$. In comparison with all the others, the band 1645 cm.$^{-1}$ is, however, very narrow and well defined. [See Abstract 1082 (1933).] T. H. P.

3599. Raman Spectra of Heterocyclic Organic Compounds. M. Milone and G. Müller. *Accad. Sci. Torino, Atti*, 68. 3. *pp.* 337–343, 1933.—The substances studied were ethyl-methyl furazane, oxy-diazole, and azoxime. Frequency shifts of about 2930 and 990 cm.$^{-1}$, due to the C—H and C—C linkages, were found, as well as one of about 1450 cm.$^{-1}$ recently identified by Borino in quinoline, isonitriles and benzanilide. This is attributed to the C=N linkage. J. H. A.

3600. Raman Spectra of Iodides. Part II. Ethyl, Propyl and Isobutyl Iodides. N. G. Pal. *Indian Journ. Phys.* 7. *pp.* 519–529, *May* 20, 1933. *In English.*—The results of a study of the Raman spectra of ethyl, propyl and isobutyl iodides are described. In order to prevent the liquid becoming coloured due to photochemical decomposition continuous distillation is maintained during the exposure. Besides, the free iodine which is not removed by this means is removed completely by means of copper wire placed suitably in the path of the distillate. Isobutyl iodide is studied for the first time. In all cases several new frequencies have been obtained. [For Part I see Abstract 5030 (1932).] AUTHOR.

3601. Raman Effect of Aqueous Nitrate Solutions. P. Grassmann. *Zeits. f. Physik*, 82. 11–12. *pp.* 765–766, *May* 30, 1933.—Photometer curves are reproduced for the Raman line $\Delta\nu = 1048$ cm.$^{-1}$ given by 65 % nitric acid and by 8 normal aqueous solutions of the nitrates of silver, lithium and calcium, using a spectrograph with a dispersion of 7 to 9 Å/mm. In no case is there any evidence of fine structure, but the line is wider for the acid than for the salts. The Raman spectra of aqueous solutions of some other nitrates are also photographed with another spectrograph with a dispersion of about 16 Å/mm. in the region concerned. The line $\Delta\nu = 720$ cm.$^{-1}$, which is double in the case of calcium and cadmium nitrates, is found to be single for strontium, zinc, ammonium and silver; it is very wide for strontium, narrower for zinc and sharpest for ammonium and silver. L. A. W.

3602. Width of the Raman Line $\Delta\nu = 992$ cm.$^{-1}$ of Benzene. P. Grassmann. *Zeits. f. Physik*, 82. 11–12. *p.* 767, *May* 30, 1933.—The width of the Raman line $\Delta\nu = 992$ cm.$^{-1}$ of benzene, as photographed with a spectrograph with a dispersion of 9 Å/mm. in the region concerned, is found to be no greater than would be produced by the instrument itself and by temperature fluctuations during the exposure. Thus it is not possible with this dispersion to obtain a value for the true width of the line, which must be less than 3 cm.$^{-1}$. L. A. W.

3603. Structure of Principal Raman Line of Benzene. L. and E. Bloch. *Comptes Rendus*, 196. *pp.* 1787–1788, *June* 12, 1933.—Four, and perhaps five, satellites accompany the Raman line of benzene, 992 cm.$^{-1}$, having $\Delta\nu - 13{\cdot}8$, $-6{\cdot}8$, $+8{\cdot}4$, $13{\cdot}7$, and $+3{\cdot}1$, of intensities 0, 1, 12, 0 and (?) respectively, that of 992 being 20. [See Abstract 1250 (1932).] C. A. S.

3604. Vibration Spectra and Structure of the Cyanogen Halides. W. West and Marie Farnsworth. *J. Chem. Phys.* 1. *pp.* 402–405, *June*, 1933.—The Raman spectra of the cyanogen halides in the liquid state or in alcoholic solution contain 3 frequencies, ν_1, ν_2, and ν_3. In the order chloride, bromide, iodide, $\nu_1 = 2201$, 2187, 2158 cm.$^{-1}$; $\nu_2 = 729$, 580, 470; $\nu_3 = 397$, 368, 321; the order of intensities of Raman transitions is $\nu_1 > \nu_2 > \nu_3$. The relative values of the frequencies indicate a linear arrangement of the nuclei in the lowest electronic state of these molecules, and the data are in accord with the structure $X - C \equiv N$ rather than $X - N = C$. AUTHORS.

3605. Raman Spectra of Ring Compounds. Part I. Mono-Substituted Benzene Compounds. J. W. Murray and D. H. Andrews. *J. Chem. Phys.* 1. *pp.* 406–413, *June*, 1933.—An improved apparatus for the study of Raman spectra has been developed. The use of filters including nitro-benzene for removing violet light, sodium nitrite for removing ultra-violet and copper nitrate for the removal of red light, has been discussed. The Raman spectra of *n*-butane, chlorobenzene, bromobenzene and iodobenzene have been reinvestigated and several new lines found in each. The Raman spectrum of α-chloropyridine has been studied for the first time and found very similar to that of chlorobenzene. AUTHORS.

3606. Dependence of the Intensity of the Raman Scattered Radiation of Quartz on the Exciting Frequency. L. S. Ornstein, J. J. Went and A. H. W. Aten, Jr. *Zeits. f. Physik*, 82. 11–12. *pp.* 750–753, *May* 30, 1933.—The intensity of the Raman radiation scattered from quartz is measured for various frequencies of exciting radiation. Within the limits of experimental error the intensity is proportional to the fourth power of the exciting frequency. J. E. K.

3607. Raman Effect in the Sphere of X-Rays. W. Kast and F. Würstlin. *Zeits. f. Physik*, 81. 9–10. *pp.* 581–583, *April* 7, 1933.—The modification of a light quantum by an atom, analogous to that by a molecule in the Raman effect, though repeatedly alleged by certain Indian investigators, has not yet been confirmed by European or American workers [see Abstract 1036 (1930)]. The author has now repeated an experiment by Bhargava and Mukherji for which adequate details are given. Nickel foil is penetrated by AgKα radiation and a band is observed which has a sharp edge at 1019·7. Now this edge just coincides with the mercury line HgLγ. Another experiment is described by the same authors with CuKβ radiation, but here again the result is probably falsified by the ZnKα line at 636·4. E. E. F. d'A.

3608. Construction of a Spectrograph with Large Luminosity. A. C. S. van Heel. *Rev. d'Optique*, 12. *pp.* 49–69, *Feb.*, 1933.—The object of the paper is to develop principles which will serve as a guide in the design of a prismatic spectrograph with large luminosity in the region 2000–13,000 Å. The brightness of the spectrum is calculated and the effect found of the inclination of the photographic plate and the length of the collimator. Except for light losses by reflection and absorption it is shown to be an advantage to have large angular dispersion. In the design of the instrument the following factors are considered; effective size of the monochromatic image of the slit, detail of the image, tolerances of refractive index of the prism, use of liquids for dispersion, and deviations from the symmetrical position. It is shown that ethyl cinnamate ($C_{11} H_{22} O_2$) is preferable to a glass prism for the visible and infra-red regions, having a larger dispersion for the same light losses. Types of spectroscopes are then described which have large luminosity and satisfy the required conditions. For the ultra-violet region, quartz and water prisms are used, water having the advantage since it can be used to 2000 Å, costs less and there is no double refraction as for quartz. For tests extending beyond 30 min. temperature regulation is necessary. R. S. R.

3609. Infra-Red Spectrometer. A. Bayle. *Rev. d'Optique*, 12. *pp.* 124–131, *March*, 1933.—Describes the construction of an infra-red spectrometer of the constant deviation type, employing a rock-salt prism and, as detector, a thermopile. W. S. S.

3610. Large Crystalline Quartz Double Monochromator. W. E. Forsythe and B. T. Barnes. *Rev. Sci. Instruments*, 4. *pp.* 289–294, *May*, 1933.—The monochromator described has two Cornu prisms 10 cm. high and 15 cm. along the base. The mounting is such that these always remain in the position of minimum deviation. Four lenses are employed, each having a diameter of 12 cm. and $F_{\lambda 2300} = 42$ cm., $F_{\lambda 34,000} = 52$ cm. Great care is taken over the elimination of stray radiation. The instrument is being used for the measurement of the intensity of the ultra-violet, the visible and the infra-red radiation from different sources. A noteworthy feature of this monochromator is its large light gathering power. It may also be used photographically as a spectrograph. A. H.

See also Abstracts **3286, 3287, 3424, 3474, 3479, 3490, 3497, 3510, 3693, 3703.**

VISION.

3611. Visual Reception. J. Guild. *Report of Phys. and Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 1–26.—The author discusses, from the point of view of a physicist, some of the major problems of general interest in connection with the theory of the operation of the visual mechanism. It is shown that by directing attention, in the first instance, to the functions of physiological units extending from the receptor organs to the visual centres the behaviour of such units can be deduced as special cases of quite general laws governing the behaviour of all types of apparatus used for the detection of radiation. From these general considerations, taken in conjunction with the funamental empirical fact that three independent controls are necessary and sufficient in every colour-matching apparatus, it is shown that vision is characterised by the simultaneous operation of three independent reception systems of dissimilar peripheral and central properties. Each independent system owes its distinctive properties to the resultant of the activities of many elementary systems in simultaneous cumulative operation, and the relations which must hold between the peripheral and central properties of the various members of such cumulative groups are discussed. Attention is also drawn to the fact that certain phenomena, usually regarded as necessary consequences of the triplicity of reception systems, do not necessarily follow from it, and have to be proved or disproved by evidence of a different character. Some problems relâting to the discriminative functions of vision are also discussed. These concern the interpretation of the Weber fraction and the manner in which *adaptation-gradient* should be taken into account in considering the significance of *sensitivities* of this kind. Some questions are asked bearing on the all-or-none principle of neural activity in relation to recruitment theories of retinal action. AUTHOR.

3612. Weber-Fechner Law. R. A. Houstoun. *Report of Phys. and Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 167–181.—If S denotes the sensation of brightness, the author has shown previously that S is a probability integral when expressed as a function of the logarithm of the intensity, and he has also made it probable that acuity of vision varies as $\sqrt{S}$. The present paper describes observations by ten additional observers to test these laws further. AUTHOR.

3613. Theory of Brightness-Constancy and General Theory of Vision. K. Koffka. *Report of Phys. and Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 182–188.—In this paper an attempt has been made to develop a theory of brightness-constancy as a branch of a general theory of vision, the aim of which must be to explain why the things which we see look as they do. A few simple cases of stimulation are selected in which it is possible to deduce from a small number of assumptions the qualities of the perceived neutral colours. It is shown that these deductions are in agreement with known experiments, and further experimental evidence is adduced in corroboration of them. Finally, some general propositions about visual perception are formulated. AUTHOR.

3614. Sensation of Light as a Photochemical Process. D. Roaf. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 189–193.—The effect of light on the retina is considered as a photochemical process, and the relations between the minimum perceptible change in intensity and the total intensity are contrasted for unimolecular and bimolecular reactions. The experimental results of Koenig and Brodhun and of Houstoun are adapted to these reactions and show that the re-combination of the photosensitive substance in the retina does not follow a unimolecular reaction. Houstoun's results are adjusted to fit the theoretical bimolecular curve and the constants of the reaction are deduced. These are in agreement with Hecht's experiments on the visual purple and intensity-discrimination. The following conclusions are reached : (*a*) The photosensitive substance does not exhibit a unimolecular reaction ; (*b*) a bimolecular reaction fits the experimental results accurately. AUTHOR.

3615. Interpretation of Quantitative Data in Visual Problems. J. Guild. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 60–87.—The paper deals with the nature of the measuring-processes employed to evaluate the photometric and colorimetric quantities in terms of which exact knowledge of the behaviour of the visual organ as a whole has to be expressed. Preliminary consideration is given to the essential nature of quantitative relations in general and to the implications of the term " measurement " as applied to the experimental evaluation of magnitude on quantitative numerical scales. The photometric and colorimetric processes are then examined, in the light of these implications, in order to determine the nature of the entity or entities which are measured by them. The assumptions which have to be made in attaching the conception of quantity to these entities, and the circumstances within which they can be regarded as having measurable magnitudes, are discussed. AUTHOR.

3616. Problems of Vision. J. Parsons. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 272–276.—The paper comprises a note on the problem of psycho-physical measurements. AUTHOR.

3617. Trichromatic Theory and its Explanatory Power. F. Allen. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 27–52.—In this paper there is assembled some of the strongest and most direct evidence for the establishment of the trichromatic theory of vision. This evidence includes some of the experimental work of König, Abney and the writer, as well as Helmholtz's theoretical treatment of König's measurements. The remainder of the paper is designed to show how the leading phenomena of normal and abnormal colour-vision may be explained in terms of the trichromatic theory of Young. AUTHOR.

3618. Essence and Present Position of the Trichromatic Theory. W. Peddie. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 102–111.—An attempt is made in this paper to make it clear that any completed theory of colour-vision must express not merely the fact of trichromasy but also the necessary mutual independence of three fundamental sensations only. Other fundamentals may be introduced into the expression of a theory, but the expression is incomplete until sufficient relationships amongst them are formulated. There is therefore no gain to be realised by a continuation of the quarrel between multichromatists and trichromatists, which has lasted for nearly a century. It may be, for example, that the formal use of a quadruple set of fundamentals, with a single definite relationship amongst them, possesses correspondence to a real physiological or psychological condition. Special consideration is made of recent strictures on some of Helmholtz's work. AUTHOR.

3619. Colour-Vision. H. Hartridge. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 60–91.—Three phenomena of colour-vision are discussed: (1) the seeing of blue objects by light containing no blue rays; (2) the seeing of yellow by red-blind and green-blind persons; (3) the seeing of white by the green-blind periphery of the retina. AUTHOR.

3620. Sensitiveness of the Eye to Differences in the Saturation of Colours. L. C. Martin, F. L. Warburton and W. J. Morgan. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 92–101.—Experiments have been made on the sensitiveness of the eye to differences in the saturation of colours by determining, for the right eyes of two observers: (1) the number of perceptible steps between the spectral colours and white; (2) the photometric amplitude of the first step of the series. The white was the British N.P.L. standard white. AUTHORS.

3621. Measurability of Sensations of Hue, Brightness or Saturation. L. F. Richardson. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 112–116.—It has been shown to be possible to make direct intuitive mental estimates of the intensities of various visual sensations. This opens up the prospect of a psychophysics which shall be quantitative as to both sensation and stimulus. [See following Abstract.] AUTHOR.

3622. Measurement of Visual Sensations. N. R. Campbell. *Phys. Soc., Proc.* 45. *pp.* 565–590, *July* 1, 1933.—The paper is a criticism of L. F. Richardson's proposed method of measuring sensations by " mental estimates " [see preceding Abstract]. In the absence of agreed principles the discussion is conducted in the light of an analogy with thermometry. It is argued (1) that Richardson's own facts prove that the method of mental estimates is inferior to another available method of measuring the same thing. If his facts and his implied propositions are true, indirect measurement by means of his S must be preferable to direct measurement by R; (2) that any arguments that Richardson might base upon the fact that his method of measurement leads to a numerical law between R and S would be valid only if proved that this law is true and not empirical; (3) that if his method measures anything, that something is almost certainly not a sensation; at least, that he has provided no evidence that it is a sensation. Finally it is pointed out that Richardson's method indicates the theoretical possibility of a method of measurement based upon ordering differences of increasing degree; but there is no evidence that the method is ever practically possible. AUTHOR.

3623. Fundamental Colours and the Colour Triangle. J. Drever. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 53–59.—Psychologically there are four pure colours, red, yellow, green and blue. The average of a number of determinations of these made at the Psychological Laboratory, University of Edinburgh, gave yellow 568 mμ, green 508 mμ, blue 471 mμ and red the spectrum beyond about 640 mμ. These determinations are in close agreement with those made by Westphal and by Purdy. The regions of the spectrum which do not show the Bezold-Brücke phenomena appear to be approximately the same. Thus a recent investigator found the unvarying points at 571 mμ, 506 mμ and 474 mμ. The physiologically stable yellow and blue in perimetry were found by Baird at 569 mμ and 461 mμ. It seems therefore absurd to deny yellow the status of a fundamental colour. The adequacy of the colour-triangle as a method of representing the world of colour-sensations is open to question. Colours vary in hue, in saturation and in brightness. The world of colour is therefore tridimensional and its adequate representation by any plane figure is impossible. AUTHOR.

3624. Colour Triangle and Colour Discrimination. T. Smith. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932, *pp.* 212–226.—The importance of a proper understanding of the colour triangle, which is a device for recording the colour relations of physical stimuli, is emphasised. Its use for other purposes requires special justification. The spectral locus of the C.I.E. colour triangle determined by Guild and Wright is considered in conjunction with Jones's determinations of hue discrimination. Considered in this way several features which appear in the latter when expressed in terms of wave-lengths disappear. Correlations of this kind may be used to infer the changes in the stimulus which correspond to differences of colour sensation, and hence the colorimetric properties of the stimuli which correspond to the physiologically primary colours. Existing data are inadequate for the proper determinations of these colours. AUTHOR.

3625. Influence of Intensity, Colour and Retinal Location on the Fusion Frequency of Intermittent Illumination. S. Hecht and C. D. Verrijp. *Nat. Acad. Sci., Proc.* 19. *pp.* 522–535, *May,* 1933.—Measurements were made of the critical flicker frequency n for a 2° circular centre field in a 10° surround field of fixed brightness equal to the mean brightness of the centre field, for a range of retinal illuminations I (white light) from about 10^{-4} to 10^{+4} photons and for foveal, 5° parafoveal, 15° parafoveal, and 20° parafoveal vision. For foveal vision, n plotted against log I gave a nearly straight, ascending line up to log I = approximately 2, and then n attained a maximum and began to decrease. In the parafovea, the curve of n against log I was more complex; at higher intensities I its shape resembled that of the foveal curve displaced downwards, but at lower intensities the curve flattened out and finally descended to $n=0$. The two regions of the curve are identified with dominance of cone and rod vision respectively. Measurements made with approximately monochromatic light (Wratten monochromatic filters) in place of white light, showed that in the parafovea the low intensity portion of the curve progressively changes its shape from that just described, to reduce finally to the foveal curve, as the wave-length is varied from 0·45 μ to 0·67 μ. In the high intensity range, the shape and position of the curve is independent of colour. Theoretical derivations of the form of the critical frequency curves are made, assuming a bimolecular photochemical reaction in the rods and cones, and postulating that flicker occurs when the concentration of the photosensitive substance fluctuates by at least a given amount. W. S. S.

3626. Quantitative Formulation of Colour-Vision. S. Hecht. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 126–160.—The following paper accomplishes two things. First, it shows that the five properties of colour-vision for which quantitative data are independently available—namely, colour-mixture, spectrum luminosity, hue-discrimination, complementary colours, and spectrum saturation—are all interrelated in fairly simple mathematical terms. Secondly, it shows that all these properties may be numerically derived from the hypothetical sensibility-distribution in the spectrum of three elements which are assumed to be the retinal receptors for colour-vision. AUTHOR.

3627. Significance of Colour-Fatigue Measurements. W. D. Wright. *Report of Phys. & Optical Societies, Disc. on Vision, held June* 1932. *pp.* 117–125.—It is shown that when the eye is fatigued the depression in sensitivity of the eye must consist in reality of separate depressions along the three visual response paths. On this basis it should be possible to calculate the response curves of the eye by combining measurements of fatigue with the known trichromatic distribution curves. This possibility is analysed qualitatively and discussed in relation to possible fatigue processes. A brief outline is given of some experiments already carried out together with some preliminary results. The discussion and experiments are limited to cone vision in the fovea. AUTHOR.

3628. Laws of Establishment of the Chroma. H. Pieron. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 277–280. *In French.*—By means of a specially constructed apparatus whereby a uniform monochromatic illumination can be substituted, during a period adjustable at will, for achromatic illumination, it has been possible to study the establishment of the chroma during constant luminous excitation. The saturation perceived increases with time of excitation up to a maximum which is reached the quicker the higher the luminosity employed; it then decreases in a continuous manner, by chromatic adaptation. For equal luminosities, the red chroma is established more quickly (by about 25 %) than the blue, according to direct determinations and to determinations by the reaction-time method. These results confirm the hypothesis put forward in 1923 to account for the mechanism of the production of the Fechner-Benham subjective colours. AUTHOR.

3629. Equivalent Adaptation Levels in Localised Retinal Areas. W. S. Stiles and B. H. Crawford. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 194–211.—The paper shows how the notion of retinal adaptation can be placed on a quantitative basis. The state of a localised retinal area under an arbitrary conditioning stimulation is specified by reference to a standard scale of stimulations—the equivalent background brightness scale or the equivalent surround brightness scale. The equivalent background (or surround) brightness should be independent of the test used to determine it, and experiment shows this to be true for the equivalent background, but with the equivalent surround certain unexplained deviations are observed. The use of the equivalent background brightness as a foundation upon which theories of the mechanism of retinal adaptation can be based is illustrated by examples. A practical application of the equivalent background brightness to the definition of a coefficient measuring the reduction of visibility due to glare is mentioned. AUTHORS.

3630. Retinal Action Time. H. Banister. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 227–235.—If a pendulum swings freely in a vertical plane its apparent path is elliptical when viewed by one eye normally and by the other through a dark glass.

The magnitude of the illusion is, within wide limits, independent of the actual intensity of the illumination : it depends on the ratio of the intensities at the two eyes. It is suggested that the effect is due to the difference in retinal action times. With a ratio of intensities of 0·51 the action time in the eye less strongly stimulated is about 0·004 sec. greater than in the other eye ; with a ratio of intensities of 0·05 the delay is about 0·018 sec. The experiment gives evidence for an " indifference range," which is perhaps due to irradiation effects. AUTHOR.

3631. Physiological Significance of the Retinal Synapses. R. Granit. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 263–271.—Attention is drawn to the anatomical fact that the retina possesses the structure of a nervous centre in combination with a sensory end organ. It should therefore exhibit properties characteristic of nervous centres, such as the two fundamental synaptic reactions of summation and inhibition. The author then proceeds to review some recent experimental evidence establishing the presence of both these reactions in the retina. The paper is concluded by a few remarks on the necessity of including the synaptic factors in theories of perception. AUTHOR.

3632. Properties of Receiving-Organs in the Retina. H. E. Roaf. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 313–319.—Colour being a sensation, its relation to wave-length of radiation may not be simple. Wave-length-discrimination may require greater differences with monochromatic than with heterochromatic radiation. A blue sensation may be produced by radiation in which no blue light is present. Acuity of vision differs from resolving power because the shorter wave-lengths are less efficient. These observations and experiments on the interference of one light with another suggest that colour-vision depends upon three groups of receptors, one sensitive to the whole, a second sensitive to the longer two-thirds and a final one sensitive only to the longer one-third of the spectrum. AUTHOR.

3633. Visual Acuity and Retinal Structure. R. S. Creed. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 288–293. —The retinal distances concerned in problems of visual acuity are so small that arguments derived from geometrical optics are almost valueless. It follows from the laws of diffraction that there are often no unstimulated cones between the foveal images of easily discriminable objects. It is a question of some cones being less strongly excited than others. Additional factors which tend to blur retinal images are spherical and chromatic aberrations, astigmatism, and the difficulty of maintaining accurate fixation by muscular action. Bright illumination must intensify several of these disadvantages, yet within very wide limits increase of retinal illumination is associated with improvement in visual resolving power. It is argued that an explanation of these phenomena can only be sought in terms of border contrast, involving physiological interaction between the paths ascending from different receptor elements. Hecht's theory of the effect of illumination on visual acuity is briefly discussed and subjected to criticism. AUTHOR.

3634. Visual Acuity and Resolving-Power of the Eye. H. Hartridge. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 309–312.—The eye suffers from chromatic aberration and yet achieves, with a 3 mm. pupil, nearly three-quarters of its theoretical

resolving power; moreover the effects of chromatic aberration are not ordinarily observed. These and some kindred observations are discussed.
AUTHOR.

3635. Dark Adaptation of the Human Eye. A. Brückner. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 161–166. *In German.*—Experiments with the Nagel adaptometer to determine the thresholds with increasing dark-adaptation, and with an exactly determined duration of excitation ($\frac{1}{10}$, $\frac{1}{30}$, $\frac{11}{50}$ sec.) by the method of minimal alterations, gave curves of a usable kind. The thresholds lie correspondingly higher than with continuous illumination. However desirable it may be to fix exactly the duration of excitation, such a procedure is too complicated for clinical purposes; and since, with the dull-illumination apparatus of the eye phenomena produced by conditioning (simultaneous contrast, successive contrast and secondary images), as our own experiments show, are almost completely absent, it further appears allowable to make an application of the duration results. With guidance from H. K. Müller, a standard curve of dark-adaptation was made, by the customary method, by Geneviève Matthey for 54 persons, which, on statistical evaluation of the distribution, makes possible the estimation of the normal or pathological character of a given adaptation curve. The experiments show that probably there are four different normal types of adaptation-range, classified according to the levels of the initial and final thresholds. AUTHOR.

3636. Recent Views on Accommodation. A. v. Pflugk. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 281–287. *In German.*—Accommodation in the eye of the ape and of man is not destroyed even by aperturing the sclera and opening the vitreous-humour chamber; accordingly the Helmholtz theory is untenable. Observations which are free from objection have not yet been made on the accommodative slackening of the zonule in a fully accommodating eye. Loosening of the lens as a proof of the actual slackening of the zonule can only be established in the case of elderly people, or in eyes that have undergone a pathological alteration or have been subjected to the action of a drug, concerning the action of which on accommodation we cannot as yet speak with certainty. As the zonule is considerably more extensible than the lens-capsule, a change of form of the lens merely by the pull of the fibres of the zonule is ruled out. The radius of the lens cavity at the anterior pole is, after removal of the cornea and lens, about 13 or 14 mm.; the radius of the lens, after separating it from the zonule and vitreous humour, is not less than 8 mm.; and therefore the accommodated lens of radius 5 or 6 mm. cannot at all be regarded as "approximating to the unstrained condition." It is necessary to admit the action of an external force on the lens, which, in the absence of any other connection of the lens with its surroundings, can only be the pressure of the vitreous humour, *with the zonule unslackened.* The lens is rather a plastic than an elastic body. AUTHOR.

3637. Mechanism of Accommodation and the Recession of the Near Point. E. F. Fincham. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 294–308.—Some differences of opinion exist regarding the relative importance of the functions of the ciliary muscle and the lens in causing the reduction in amplitude of accommodation which accompanies increasing age. In this paper it is sought to show that the author's capsular theory of accommodation, considered in the light of the newer conception of the zonule as forming an elastic suspension of the lens, offers an explanation of the progressive recession of the near point and the clinical symptoms of presbyopia, upon the assumption that the significant change in the mechanism with age is the sclerosis of the lens substance. It is contended that this change necessitates a greater ciliary-muscle contraction for the production of a unit increase in physical accommodation, and that a reduction in the power of the muscle is unnecessary to explain mechanically the effects observed in presbyopia. AUTHOR.

3638. Visual Perception of Depth. F. C. Bartlett. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 236–243.—Some simple stereoscopic experiments are described which demonstrate that, while the binocular perception of depth has a physiological basis in retinal disparation, psychological factors of "object interpretation" always play an important part. The monocular perception of distance is briefly discussed and it is suggested that in many important cases this is mediated by muscular or kinaesthetic functions. An explanation of how the psychological factors involved in visual depth-perception operate is attempted. AUTHOR.

3639. Refractive Conditions for the Peripheral Field of Vision. C. E. Ferree and G. Rand. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 244–262.—The refraction of the eye in the temporal and nasal peripheral field as far out as 60° has been studied by means of a Zeiss parallax refractionometer modified to suit the purpose. Twenty-one eyes have been examined, selected to include both slight and pronounced central errors of refraction. The eyes examined fall into three classes: in type A, the eye becomes more myopic in the horizontal plane as the periphery of the field is approached and more hyperopic in the vertical plane. In all eyes examined but one (in which there was a high myopic astigmatism in the central field), this resulted in a mixed astigmatism in the peripheral field, the interval of Sturm varying over a considerable range of dioptres. In type B, the eye becomes less myopic in the horizontal plane and more hyperopic in the vertical plane. This results in a condition of compound hyperopic astigmatism in the peripheral field for eyes that are hyperopic, emmetropic and moderately myopic in the central field. If there is strong myopia at the centre of the field, it is obviously possible that a compound myopic astigmatism might result over the greater part of the peripheral field, weakening in amount as the periphery is approached. In type C, the refractive condition is asymmetrical for the nasal and temporal halves of the field. The general trend of this asymmetry, as the periphery of the field is approached, is toward greater myopia or less hyperopia, as the case may be, for one-half of the field than for the other half. Principles for the analysis and interpretation of the results for peripheral refraction are given and various aspects of the scientific and clinical importance of studying the refractive conditions of the peripheral field are noted and discussed. AUTHORS.

3640. Subjective Tests for Astigmatism. D. F. Roessler. *Report of Phys. & Optical Societies, Disc. on Vision, held June,* 1932. *pp.* 320–325.—The paper describes the testing of astigmatism by means of the chromatic aberration observed with a cobalt lamp. AUTHOR.

X-RAYS.

3641. H.T. Generators for X-Ray Apparatus. E. H. W. Banner. *Brit. J. of Radiology,* 6. *pp.* 360–377, *June,* 1933.—Modern methods of generating the high voltage required for the excitation of X-ray tubes are discussed from the electrical aspects of efficiency, effect on the apparatus, and possibility of direct measurement. The direct current supply from transformers and valve rectifiers with condensers is shown to be the best from the above electrical aspects, and it is suggested that standardisation on this or some similar circuit could well be discussed, to the ultimate advantage of the manufacturer and the user. The Greinacher circuit using two valves and two condensers is dealt with in some detail, and test results on an experimental low-voltage circuit of this type are given and discussed. From these results are deduced some points in design and an outline specification for a continuous voltage plant for 100 mA. and up to 80–90 kV. These results are also analysed and found to conform to calculations. Other desirable features in design include voltage selection in only three or four steps, control by tappings on the primary of the transformers, X-ray tube current setting by filament rheostat, and exposure controlled by a watt-second relay so as to minimise the effect of line voltage fluctuations. The curves provide data for the calculation of the transformer r.m.s. secondary current for a given X-ray tube current as well as showing the ratio of peak to r.m.s. voltage for various loads. A circuit shows the arrangement and instruments necessary to measure peak and r.m.s. voltage and peak, r.m.s. and mean current. E. H. W. B.

3642. Comparison of H.T. X-Ray Generators. L. S. Taylor and K. L. Tucker. *Am. J. of Roentgenology and Radium Therapy,* 29. *pp.* 826–843, *June,* 1933.—A paper chiefly consisting of graphs and practical detailed measurements, respecting the relative efficiencies of various h.t. X-ray excitors, namely ; a mechanical rectifier with a single transformer, a mechanical rectifier with a split h.t. secondary and a constant potential apparatus. Intensity measurements were made, after copper filtration, by the ionisation action in air. The authors summarise their results in expressing the view that the measurements show rather physical similarities, rather than differences, after allowing for the various secondary factors, although it is particularly expressed that the results are for ionisation action and not for biological action. It is shown that equivalent depth doses are obtained with the different generators over a wide range of radiation quality and intensity. In the clinical applications, the application is dependent upon purely clinical and not physical factors, the first of which is the relationship between quality and erythema dose, and the second, in respect to the economic factors involved in actual treatment. It is particularly pointed out that it is not economical to use highly-filtered radiation developed at low voltage, when it is possible, at higher voltage, to obtain a much greater intensity with less filtration. B. J. L.

3643. Anomalous Scattering of X-Rays by Copper. A. A. Rusterholz. *Zeits. f. Physik,* 82. 7–8. *pp.* 538–550, *May* 15, 1933.—The scattering function of copper is measured for the K_α-line of zinc whose wave-length is close to that of the K-absorption edge of copper. The difference between the observed values and those calculated by Hartree's method, which can be attributed to a change in the scattering power of the K-electrons, is found to be independent of the scattering angle. The atom factor of the (220) plane of copper is determined for a number of wave-lengths on the long wave-length side of the copper absorption edge, and its dependence on wave-length compared with that calculated from dispersion theory. Good agreement is found. C. B. A.

3644. Effect of Temperature on the Intensity of X-Rays Scattered by Powdered Sodium Fluoride. J. J. Shonka. *Phys. Rev.* 43. *pp.* 947–954, *June* 15, 1933.—The ratio of the integrated intensities of a number of regularly reflected X-ray lines from powdered sodium fluoride crystals at room- and liquid-air temperatures has been studied by means of a photographic method. The results of the experiments show that the ratio varies with the angle as predicted by the Debye-Waller formula. The characteristic temperature of sodium fluoride was found to be equal to 442° K. This value agrees as well as one could expect with values calculated by the Lindemann melting-point formula and the known characteristic temperatures of sodium chloride or potassium chloride crystals. Using the known structure factor of sodium fluoride atoms at room-temperature and assuming zero-point or no zero-point energy the structure factors of the atoms at rest have been calculated. A comparison with the theoretical structure factors of sodium fluoride and neon (sodium fluoride atoms are neon-like) and with the known experimental structure factor of gaseous neon atoms indicates that the assumption of zero-point energy is correct. The square root of the mean square amplitude of thermal vibration of the sodium and fluorine ions at room-temperature was found to be equal to 0·182 Å. AUTHOR.

3645. Measurements of Intensity of Compton Modified Radiation by Means of Filters. E. O. Wollan. *Phys. Rev.* 43. *pp.* 955–963, *June* 15, 1933.—A new method of measuring the ratio of the intensity of the modified to the unmodified scattering by using a triple balanced filter has been developed. With the K_a radiation of molybdenum three balanced absorption filters containing zirconium, yttrium and strontium, respectively, make it possible to absorb or transmit either the modified or unmodified K_a lines or both if the angle of scattering is sufficiently large so that the shortest wave-length of the modified line is greater than the critical absorption wave-length of yttrium. This method makes possible measurements of the modified radiation not only for the scattering by solids, but also for the scattering by gases, for which case the theory and experiment can be directly compared. Measurements of the ratio of intensity of the modified to the unmodified scattering have been made at $\phi = 120°$ for oxygen, nitrogen and argon, as well as for several solid elements and compounds. The results for gases are found to be in good accord with the wave-mechanics theory of scattering as developed independently by Wentzel and Waller. AUTHOR.

3646. Diffraction of X-Rays by Liquid Sulphur. A. H. Blatchford. *Phys. Soc., Proc.* 45. *pp.* 493–500, *July* 1, 1933.—The X-ray diffraction effects given by liquid sulphur at various temperatures between 130° and 260° C. are measured. The results indicate that the diffraction is caused by an unstable grouping of atoms of sulphur; the grouping becomes less pronounced with increased temperature, and changes in form gradually up to 220° C., when there is a sudden alteration corresponding to the change from the form S_λ to S_μ. Raman and Ramanathan's theory of X-ray scattering by liquids is found to be applicable to some extent at temperatures near the melting-point. AUTHOR.

3647. Reduction of Chromate Solutions by X-Rays. H. Fricke and E. R. Brownscombe. *Am. Chem. Soc., J.* 55. *pp.* 2358–2362, *June*, 1933.—In 0·8 *N* sulphuric acid $3·31 \times 10^{-6}$ equivalents of potassium dichromate are reduced per 1000 cc. for each 1000 *r* of X-ray dosage, independent of chromate concentration and of temperature (between 5 and 90°). The dependence on sulphuric acid concentration has been determined. The results indicate that the reduction is due to a primary production of an activated form of H_2O_2 from the water. Traces of organic substances increase the action of the rays catalytically. AUTHORS.

3648. Weak Lines in the K-Spectra of the Elements Rh 45 and Mo 42. H. Hulubei and (Miss) Y. Cauchois. *Comptes Rendus*, 196. *pp.* 1294–1297, *May* 1, 1933.—A number of weak lines in the K-spectrum of Rh have been measured, including β_4, β_5, and β_0. β_4 had not previously been recorded and probably corresponds to a forbidden transition K–$N_{IV,V}$ (*cf.* Mo, Pd, Ag). This would give to the level $N_{IV,V}$ the value 0·25. β_5, also observed by Ross, is also a forbidden line. β_0 may correspond to a doubly-ionised atom. It has been observed in Mo, where β_4 and β_5 also appear. A number of weaker rays between β_5 and β_1 have been observed, but no interpretation is attempted. C. B. A.

3649. X-Ray Emission Spectra of Gaseous Elements: K Spectrum of Krypton. (Miss) Y. Cauchois and H. Hulubei. *Comptes Rendus*, 196. *pp.* 1590–1592, *May* 22, 1933.—The K spectrum of krypton, determined by the author's method with Se, Br and Rb as reference elements, includes $K\alpha_2$ 982·1, $K\alpha_1$ 978·1, $K\beta_{1,3}$ 876·7, and $K\beta_2$ 864·3. C. A. S.

3650. Structure of K-Lines of Light Elements. A. Hautot. *J. de Physique et le Radium*, 4. *pp.* 236–246, *May*, 1933.—A spectrograph combining the advantages and avoiding as far as possible the disadvantages of a concave grating of large radius of curvature and grazing incidence and working *in vacuo* is described. With this and special plates the fine structure of the $K\alpha$ lines (hitherto regarded as merely wide) of carbon and boron have been determined, showing that the $K\alpha$ spectrum of carbon is similar to that of the heavier elements, and that its components are deducible by Moseley's law. [See Abstract 1103 (1933) and the following Abstract.] C. A. S.

3651. Structure of K-Spectra of Very Light Atoms. A. Hautot. *Comptes Rendus*, 196. *pp.* 1727–1729, *June* 6, 1933.—It is shown that the fine structure in the K-spectrum of carbon [see preceding Abstract] can be explained on the basis of a suggestion by Langer that initial ionisation may take place in the L_1 or L_2 levels at the same time as that in the K level [see also Abstract 1925 (1933)]. In the case of boron, this explanation is not so satisfactory, and it is still less so for beryllium. C. B. A.

3652. Probabilities of K-Electron Ionisation of Silver. D. L. Webster, W. W. Hansen and F. B. Duveneck. *Phys. Rev.* 43. *pp.* 839–858, *June* 1, 1933.—The probability of K-electron ionisation of silver by kathode rays as a function of the voltage is deduced from the author's measurements of K-line intensities (corrected for various small perturbing factors). An approximate empirical formula is probability = constant × U^{-m} log u where u is the ratio of tube voltage to minimum ionising potential and m is about 0·78. Wave mechanical calculations of the probability depend upon Born's theory which only holds when u is large. A modification of the usual quantum theory, changing the law of force between the kathode rays and the K-electrons to an inverse cube, leads to a formula which agrees fairly well with experiment. There is, however, evidence that the fundamental defect in the usual quantum theory lies not so much in a departure from the inverse square law as in its dependence on the contradictions of the uncertainty principle. J. E. R. C.

3653. X-Ray Emission Spectrum and Chemical Combination. Part II. Investigations on the $K\alpha_1\alpha_2$ Doublet of Chlorine. O. Lundquist. *Zeits. f. Physik,* 83. 1–2. *pp.* 85–91, *June* 6, 1933.—A description is given of a modification of a previously described secondary ray tube [see Abstract 638 (1933)] for investigation of the dependence of the X-ray emission spectrum on chemical combination. On this the time of exposure can be shortened. The apparatus has been used for investigation of the $K\alpha_1\alpha_2$ doublet of chlorine partly with a number of chlorides and partly with the compounds $NaClO_3$ $KClO_3$, $NaClO_4$ and $KClO_4$. For the various chlorides no differences in the position of the doublet lying outside the limits of error of observation could be observed. The plates of the two chlorates and those of the two perchlorates show likewise the same doublet position within the limits of error. The distance apart of the components is the same in the three groups of compounds. It amounts on the average to 2·97 X.U. The chlorate doublet is shifted in relation to the chloride doublet on the average 2·19 X.U. towards the shorter waves, and the perchlorate 2·93 X.U. J. J. S.

3654. Fine Structure of X-Ray Absorption Boundaries. J. Veldkamp. *Zeits. f. Physik,* 80. 11–12. *pp.* 776–784, *May* 30, 1933.—Fine structures determined for Ni and Fe. That for iron in a mixed crystal is markedly different, but is identical with that of Ni, whether pure or in mixed crystal. That of metallic calcium is analogous to that of surface-centred Ni or Cu. The fine structure of nickel undergoes no change on passing through the Curie point; that of NiO shows a shrinkage at 720°C. Nickel or cobalt metal give precisely the same results as the fluorides. A. D.

3655. Formula for Diffraction by a Perfect Grating. C. Eckart. *Phys. Rev.* 44. *pp.* 12–14, *July* 1, 1933.—The present use of ruled gratings for the absolute measurement of X-ray wave-lengths makes it necessary to investigate the possibility of systematic deviations from the simple formula for the diffraction from a perfect grating. A perfect grating is understood to have the following properties: (1) It is ruled on a continuum —its material has no atomic properties. (2) The optical properties of its material are completely determined by a refractive index (which may be complex). (3) It is ruled on a perfectly plane surface. (4) Its lines are truly parallel, identical, and uniformly spaced. (5) It is infinite in extent. (6) It is so oriented that the plane of incidence and diffraction is perpendicular to the rulings (this makes the problem two-dimensional). Of these properties, only (6) is non-essential and could be eliminated at the expense of a slight complication. The property (5) results in an infinite resolving power: theoretically, the resolving power of a finite portion of a perfect grating may be calculated in a manner which is discussed. It might seem that any derivation based on the foregoing simplifications could be no more general than the usual elementary derivation. However, the latter neglects the following factors: (*a*) The influence of multiple scattering; (*b*) Refraction, if the material of the grating is transparent. (This is really a particular case of (*a*)); (*c*) Shadows cast by one ruling on its neighbours; (*d*) Surface waves, similar to those arising on total reflection at a plane surface. In this case, these are the high order spectra for which sin $\theta_n > 1$. A. H. Compton has given an elementary derivation which takes account of the factors (*a*), (*b*) and (*c*). The present calculation confirms his result that these factors do not influence the calculation of the wave-length, and extends it to include the factor (*d*). AUTHOR.

3656. Measurements of High-Voltage X-Rays. W. V. Mayneord and J. E. Roberts. *Brit. J. of Radiology*, 6. *pp.* 321–340; *Disc.*, 340–344, *June*, 1933.—A description is given of a constant H.T. generator and tube for use up to 400 kV., and the protection of the observers is discussed. Experiments have been made on the variation of X-ray output with voltage and details are given of the most suitable thicknesses of copper filters for use in X-ray therapy. The absorption of the radiations in copper and lead have been investigated and curves showing the half value layers in copper for a large range of conditions are given. Using a large water phantom and submersible ionisation chamber measurements of " back-scatter " have been made. It is shown that " back-scatter " reaches a maximum for a quality of radiation in the region of a half value layer of 1 mm. copper. A comprehensive series of measurements have been made on the distribution of radiation along the axis of the beam in a water mass. The effect on percentage depth dose of changes of focal distance, quality of radiation and size of field are investigated and curves given. Some theoretical considerations are briefly mentioned. J. E. R.

3657. X-Ray Measurement of Strain. H. Möller. *Zeits. f. techn. Physik*, 14. 6. *pp.* 217–220, 1933.—The paper refers to the determination of lattice distortion by measurements of inter-planar spacing and width of interference lines. The accuracy attainable in the measurement of inter-planar spacing by the large angle reflection method is discussed. W. E. P.

3658. X-Ray Detection of Lattice Distortion. B. Pfarr. *Zeits. f. techn. Physik*, 14. 6. *pp.* 220–221, 1933.—The paper describes the changes of line-breadth observed in large angle reflection photographs of iron specimens during the processes of cold-working and annealing. W. E. P.

3659. Reinforcement-Screens in X-Ray Spectroscopy. G. Küpferle. *Zeits. f. Physik*, 83. 1–2. *pp.* 79–84, *June* 6, 1933.—These screens show a decided intensification of the lines even with relatively soft rays (1000 X.U.) Tests made with Laue and other films. A. D.

3660. Moving Film Cameras in X-Ray Analysis. B. W. Robinson. *Journ. Sci. Instruments*, 10. *pp.* 165–169, *June*, 1933.—A description is given of two moving film cameras designed for use in the X-ray analysis of single crystals. The first is exceedingly simple to construct; the film is wrapped round a cylinder which rotates at the same speed as the crystal about an axis perpendicular to the X-ray beam and to the axis of rotation of the crystal; it has the disadvantage that it can only be used for equatorial reflections. The second is of the Weissenberg type, in which the cylindrical film moves parallel to its own axis, which is also the axis of rotation of the crystal; care has been taken to make all adjustments both simple and geometrically definite AUTHOR.

3661. X-Ray Photography of Powders at Liquid-Air Temperature. J. A. Santos and J. West. *Journ. Sci. Instruments*, 10. *pp.* 219–221, *July*, 1933.—This note describes a convenient and reliable method whereby X-ray photographs of finely powdered crystals used in the form of thin rods can be taken at liquid-air temperature. AUTHOR.

See also Abstracts 3292, 3305, 3607, 3672.

HEAT.

CALORIMETRY.

3662. Calculation of Specific Heat of Solid Bodies. K. Honnefelder. *Zeits. f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 53–64, *April*, 1933.—The object of the paper is to compare the values determined experimentally of the specific heat of copper, tungsten, cadmium, zinc, tin, rock-salt, sylvine, zincblende, fluorspar and quartz with those calculated from the Debye-Born-Karman theory. At temperatures not too low, copper, cadmium and zincblende are in good accord with theory, while there is a discrepancy of about 1 % for zinc. The agreement for tungsten and tin is also reasonable, and that for fluorspar and quartz very satisfactory. At very low temperatures, in the region of the T^3 law, tungsten, zinc and cadmium show very large divergences from the theoretically calculated values. L. G. C.

3663. Specific Heat, Melting Point and Latent Heat of Fusion of Hydrogen Fluoride. J. Dahmlos and G. Jung. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 317–322, *May*, 1933.—The specific heat of solid and liquid hydrogen fluoride was measured by means of a vacuum calorimeter over the temperature range 98° to 273° K. The melting point was found to be 190·09° K. and the latent heat of fusion of 20 gm. of HF amounted to 1094 cal. It is possible, but by no means certain, that there are transformations in the solid at 118° and 167° K. L. G. C.

3664. Latent Heats of Binary Mixtures. V. Fischer. *Ann. d. Physik*, 17. 2. *pp.* 209–220, *May*, 1933.—The three latent heats of vaporisation which a binary mixture may possess are defined. Expressions are then derived for these latent heats and also for the heat of combination of the mixture. Dana has determined the latent heat of oxygen-nitrogen mixtures at constant pressure and constant composition, and examples are given showing how the remaining two latent heats and also the heat of combination may be derived from these results. R. W. P.

3665. Ice Calorimeter for Measuring very Small Thermal Effects. W. Swietoslawski, A. Zmaczynski, I. Zlotowski, J. Usakiewicz and J. Salcewicz. *Comptes Rendus*, 196. *pp.* 1970–1973, *June* 26, 1933.—Modification of the Bunsen ice calorimeter, with a view to the detection of the continuous evolution of heat at as small a rate as 10^{-5} cal. per hr. per gm. of material tested is described. J. S. G. T.

3666. Calorimetric Method for Determining the Rates of Interdiffusion of Reacting Liquids. F. Barry and A. K. Smith. *Am. Chem. Soc., J.* 55. *pp.* 2215–2230, *June*, 1933.—This paper presents the first of a series of studies on the possibilities of the calorimetric control of protracted processes in thermally inhomogeneous systems. A method is described whereby it is possible to measure, with a precision somewhat better than 1 gm.-cal., the heat generated during four hours or more in an unstirred mass of liquid which develops a maximal vertical inhomogeneity of temperature (due to thermal stratification) of about 0·015°. By this method the rates of interdiffusion of equimolar solutions of $\mathrm{HCl\cdot Aq}$ and $\mathrm{NaOH\cdot Aq}$ have been determined, the plane of contact being at 20–25°. AUTHORS.

3667. Method of Measuring the Specific Heats of Poor Conductors. W. G. Marley. *Phys. Soc., Proc.* 45. *pp.* 591–601, *July* 1, 1933.—A brief review of existing methods of determining specific heats is given with reference to their suitability for poor conductors. The method of cooling, which has received scant attention in the past, is developed to afford an accurate and ready method. This is used to measure the specific heats of typical substances. AUTHOR.

CONDUCTION.

3668. Periodic Heating and Cooling of a Semi-Infinite Solid Having Conductivity, Specific Heat and Density Varying (a) with Temperature, (b) with Depth. Y. Kodaira. *Geophys. Mag., Tokyo,* 7. *pp.* 51–86, *April,* 1933. *In English.*—An approximation method of solving both problems is given together with the solutions worked out in detail. G. G. S.

3669. Geometry of Degenerate Heat Families. A. Fialkow. *Nat. Acad. Sci., Proc.* 19. *pp.* 543–548, *May,* 1933.—Taking v to be the temperature in a problem of uniplanar heat flow, the heat families are the curves $v = \phi(x, y, t)$, where v is the temperature, t is the time and x, y are rectangular coordinates. This is a two-parameter family, which is called degenerate if only one parameter is effectively present. The only three degenerate types are known to be included in $v = u$, $u + t$ and $ue^{\pm t}$, where u is a function of position, which satisfies a certain differential equation, different for each type. The geometry of these families, *i.e.*, the properties of the orthogonal network $u = \text{const}$, and $\frac{\partial u}{\partial x} \cdot \frac{dy}{dx} - \frac{\partial u}{\partial y} = 0$ is studied, and general theorems are established. J. H. A.

3670. Influence of Magnetic Fields on the Heat Conductivity of Gases. Part I. H. Senftleben and J. Pietzner. *Ann. d. Physik,* 16. 8. *pp.* 907–929, *April,* 1933.—It has been discovered by Senftleben [see Abstract 1309 (1931)] that the heat conductivity of paramagnetic gases is reduced by the action of magnetic fields. The present paper describes the apparatus used to confirm and to measure the effect quantitatively. Results of the measurements shown, the dependence of the effect on magnetic field-strength, pressure and temperature are discussed. It is found that the effect is independent of the field-strength when this assumes great values ; nor does the temperature influence the effect after a certain limit has been passed ; but even at *small* values of the pressure the effect no longer depends on it. The measurements are conveniently expressed in an empirical approximation formula which shows that the effect depends on the argument $H^2 T^{2n}/p^2$ (where n varies between ½ and 1) ; the limits between which the measurements were made lie between $H = 0$ to 12,000 gauss, pressure = 40 to 700 mm. Hg, temperature = 90 to 400° Abs. H. L. B.

3671. Thermal Conductivity of Water. L. H. Martin and K. C. Lang. *Phys. Soc., Proc.* 45. *pp.* 523–529, *July* 1, 1933.—The paper describes the precise measurement of the thermal conductivity of water in a range of temperatures extending from 7° C. to 60° C. The parallel-plate method has been employed, the apparatus being especially designed to cope with the difficulties which arise in the measurement of the conductivity of a volatile liquid. Two series of measurements were made, the plates in one apparatus having approximately three times the area of those in the other. Authors.

CONVECTION.

See Abstract 3668.

DILATATION.

3672. X-Ray Investigations on the Thermal Expansion of Solids. Part I. G. Shinoda. *Kyoto Coll. Sci., Mem.* 16. *pp.* 193–201, *May,* 1933. *In English.*—The thermal expansion coefficients and the lattice constants of some metals were determined by the X-ray method and the following results obtained. Expansion coefficient (10^{-6}) Al ($a = 22 \cdot 9$), Sn ($a_{\parallel} = 45 \cdot 8$, $a_{\perp} = 25 \cdot 7$). In ($a_{\parallel} = 45 \cdot 0$, $a_{\perp} = 11 \cdot 7$), Zn($a_{\parallel} = 64 \cdot 5$, $a_{\perp} = 10 \cdot 8$), Tl ($a_{\parallel} = 72$, $a_{\perp} = 9$). Lattice constant Sn ($a = 5 \cdot 824$ Å, $c/a = 0 \cdot 5415$), In ($a = 4 \cdot 581$ Å, $c/a = 1 \cdot 077$). Author.

3673. Absolute Thermal Expansion of Liquids. J. Zahradniček. *Phys. Zeits.* 34. *p.* 386, *May* 1, 1933.—Modifies Dulong and Petit's method by using two communicating U-tubes in separate baths, thus involving a considerable simplification. E. E. F. d'A.

3674. Thermal Expansion and Lattice Theory. A. Papapetru. *Phys. Zeits.* 34. *pp.* 487–490, *June* 15, 1933.—Assuming expressions for the potentials of lattice pairs in crystals of the NaCl type, an expression is derived for the coefficient of thermal expansion of cubic crystals. Satisfactory agreement is shown between theoretical and experimental results relating to 10 crystalline substances including halides and metals. J. S. G. T.

3675. Improvements in Prytherch's Capacity Dilatometer. J. L. Haughton and F. Adcock. *Journ. Sci. Instruments,* 10. *pp.* 178–180, *June,* 1933.—The improvements made in the Prytherch dilatometer [see Abstract 3331 (1932)] are described and include arrangements for operating the instrument with the specimen under examination in a strictly controlled atmosphere and at temperatures up to 1300° C. Authors.

3676. Temperature Stresses in Walls and Flat Slabs. N. S. Boulton. *Phil. Mag.* 16. *pp.* 145–163, *July,* 1933.—An investigation of stresses induced in a wall or flat slab of steel, concrete, or other fairly homogeneous elastic material, due to the heating of one face above the temperature of the other. Attention is mainly confined to a wall or slab the edges of which are free from external restraint. The stresses arise when the temperature gradient through the wall is non-uniform, *i.e.*, the temperature at any point is varying with the time. Equations are deduced for the stresses and displacements in the slab, without assuming a law connecting the temperature with the time. An equation is derived representing approximately the variable temperature distribution in a flat slab due to the heating of one face by the sun's rays. The general solution is of some interest and importance as indicating whether temperature stresses may be partly responsible for the disintegration of the faces of walls exposed to sunlight. Numerical values of the stresses and the conclusions arising therefrom are considered. The limitations of the solution near the edges of the slab are investigated. Author.

See also Abstract 3824.

EVAPORATION.

3677. Velocity of Evaporation of Liquids in a Current of Air. M. Centnerszwer, and (Miss) C. Wekerôwna and Z. Majewska. *Acad. Polonaise Sci. et Lettres, Bull.* 10*a. pp.* 369–382, *Dec.,* 1932. *In German.*—The early part of this paper is a brief discussion of the nature of evaporation and of the methods that have been used to measure the velocity of evaporation. Evaporation may be considered as a purely physical process determined by the velocity of movement of the molecules, or as a chemical process in which liquid molecules are transformed into gas molecules, the two classes of molecules being of an essentially different nature. On the latter hypothesis, the velocity of evaporation should give some information on the nature of liquid molecules. The production of convection currents in the liquid by the current of air causes an uncertainty in results which according to Sauvage, Bruxelles, 1924, has vitiated recent work. The present authors have designed their apparatus so as to reduce this uncertainty to a minimum. A diagram of the apparatus is given, together with the method of carrying out the experiment. Results are tabulated. Two cases arise. In one the experimental conditions are such that evaporation takes place practically adiabatically, and in the other isothermally. In the former the velocity of evaporation is proportional to the air velocity up to a certain value, and is then independent of air velocity. In the latter the velocity of evaporation is throughout proportional to the air velocity. The authors conclude that evaporation is of a purely physical nature. T. B.

3678. Condensation of Mercury on a Vertical Wall. R. Risch. *Helv. Phys. Acta,* 6. 2. *pp.* 128–138, 1933.—When mercury vapour condenses the pressure of the vapour is higher than the saturated vapour pressure at the temperature of the condensate because, if the condensate is to continue to form, more molecules must fall on the condensate than leave it. This phenomenon, which depends on the reflection of the molecules at the surface, is investigated theoretically and experimentally. The reflection coefficient referred to the surface of the wall on which condensation occurs amounts to 0·89 to 0·45 in the experiments. It was also found from the experiments that the resistance to the transition of heat between a vertical wall and the mercury condensate that adheres to it amounts to about 2° C. per watt/cm.^{2} H. L. B.

3679. Theory of the Psychrometer. Part I. Mechanism of Evaporation. J. H. Arnold. *Physics,* 4. *pp.* 255–262, *July,* 1933.—Neither the diffusional theory of Maxwell nor the convectional theory of August is capable of representing adequately the processes of evaporation and heat transfer occurring at the wet bulb. An examination of these processes with the aid of the Reynolds analogy between heat and vapour transfer by convection on one hand, and fluid friction on the other, indicates that the correct theory consists of a combination of the two older theories, in which a mechanism of convection plus conduction is postulated for both heat and vapour transfer. When the thermal diffusivity is equal to the material diffusivity, a special case occurs, for which all three theories give the same result. This condition is approximately satisfied for the case of water evaporating into air ; other gases or liquids must therefore be used to discriminate among the various theories. Experiments with water and four organic liquids show that the new theory represents the facts very accurately, and may be made the basis of a sound system for the reduction of psychrometric observations. AUTHOR.

MELTING AND BOILING POINTS.

3680. Purification and Physical Properties of Organic Compounds. Part II. E. L. Skau. *J. Phys. Chem.* 37. *pp.* 609–614, *May*, 1933.—Using the method of heating curves described in Part I [see Abstract 1940 (1933)], the melting points of a number of samples supplied for thermometer calibration by the Bureau International des Étalons Physico-Chimiques have been measured. They are mainly in good agreement with those found by Timmermans, who is stated in a footnote to have expressed his willingness to endorse the following revision of his " accepted values " :—

Carbon tetrachloride	$-22\cdot8_5^\circ$ C.	Carbon disulphide	$-111\cdot8_5^\circ$ C.
Chlorobenzene	$-45\cdot2_0^\circ$ C.	Ethyl ether (stable)	$-116\cdot3_0^\circ$ C.
Chloroform	$-63\cdot4_5^\circ$ C.	Ethyl ether (unstable)	$-123\cdot3_0^\circ$ C.
Ethyl acetate	$-83\cdot6_0^\circ$ C.	Methyl-cyclo-hexane	$-126\cdot3_5^\circ$ C.

J. H. A.

3681. Phenomena Occurring in the Melting of Metals. W. L. Webster. *Roy. Soc., Proc.* 140. *pp.* 653–660, *June* 1, 1933.—Experiments designed to investigate factors affecting the disappearance of crystallisation nuclei in bismuth, cadmium, lead or tin when a melt is heated above the conventional m.p. are described. In bismuth, lead and tin nuclei persist when the solid is melted. In tin the nuclei are easily destroyed and are usually not re-formed till a definite degree of undercooling is effected. In bismuth and lead the nuclei are apparently only very slowly destroyed as the melt is superheated, and to each stage of their destruction there corresponds a characteristic degree of undercooling at which what remains of the nuclei recovers the power to act as a centre of crystallisation. The nuclei exhibit a temperature hysteresis effect. An apparent lowering of the temperature of solidification of bismuth occurs in capillary tubes. J. S. G. T.

See also Abstracts 3463, 3663, 3682.

TEMPERATURE, MEASUREMENT OF.

3682. Freezing Temperature of Silver. W. F. Roeser and A. I. Dahl. *Bureau of Standards, J. of Research*, 10. *pp.* 661–668, *May*, 1933.—A study was made of the precautions which should be observed in using the freezing point of silver as a thermometric fixed point. Observations were made on three samples of silver containing various amounts of impurities. The depression of the freezing point due to absorption of oxygen was measured under a number of conditions. It was found that graphite crucibles and covers were as effective in protecting silver from oxygen as a vacuum 0·005 to 0·03 mm. of Hg. AUTHORS.

3683. Radiation Thermopiles for Use at Liquid-Air Temperatures. C. H. Cartwright. *Rev. Sci. Instruments*, 4. *pp.* 382–384, *July*, 1933.—Based on observations of thermoelectric power and the Wiedemann-

Franz ratio λ/k, a compensated radiation thermopile has been built and operated in a vacuum at low temperatures, which shows a more than tenfold increase in sensitivity, when operated at the temperature of liquid oxygen, as compared to operation at 25° C. AUTHOR.

3684. Vertical, Vacuum, Split-Tube, Graphite-Resistance Furnace. R. D. Evans. *Rev. Sci. Instruments*, 4. *pp.* 391–393, *July*, 1933.—By splitting the graphite resistor tube of a vertical, evacuated, high-temperature furnace, the construction is simplified, the possibility of resistor breakage is circumvented and the zone of highest temperature is brought deeper in the furnace than in the spiral or solid tube types of vertical furnace. The construction of the furnace cover permits crucibles to be put in or removed from the furnace without breaking the main vacuum seal. The melt can be observed visually, or the gases from the melt can be drawn off to other apparatus, without having to pass through the main furnace volume. The furnace reaches 2000° C. with a power input of 7 kW. AUTHOR.

See also Abstract 3433.

THERMOCHEMISTRY.

3685. Kinetics of the Carbon Dioxide–Carbonic Acid Reaction. R. Brinkman, R. Margaria and F. J. W. Roughton. *Roy. Soc., Phil. Trans.* 232. *pp.* 65–97, *May* 17, 1933.—Manometric and photoelectric methods are described for measuring the speed both of the forward and backward reactions of the reversible process $CO_2+H_2O\rightleftharpoons H_2CO_3$, the former being available for slow reactions (>45 sec. for half-completion) and the latter (involving Hartridge and Roughton's rapid reaction velocity technique) down to 0·01 sec. The kinetic results confirm Faurholt's view that (*i*) in the range pH 0 to pH 8, $d\,[CO_2]/dt=k\ [H_2\ CO_3]-k^1\ [CO_2]$ corresponding to the mechanism 1 mol. CO_2+1 mol. $H_2O\rightleftharpoons 1$ mol. H_2CO_3 holds good; the values of k and k^1 are independent of pH in this range and their ratio agrees fairly well with the equilibrium constant of the reaction; and that (*ii*) from pH 10–13, $d\,[CO_2]/dt=k_{H\bar{C}O_3}\ [H\bar{C}O_3]-kCO_2$, OH $[CO_2]$ $[O\bar{H}]$ becomes predominant. Between pH 8 and 10 both equations must be taken into account. The velocity constants calculated from the manometric results are consistent, and the best values are distinctly higher than those of Faurholt, the origin of this discrepancy being discussed. It is shown that existing data give no index of the heat of the reaction, $CO_2+H_2O\rightleftharpoons H_2CO_3$. An Appendix dealing with the heat of the reaction, $\overset{+}{H}+\overset{-}{CO}_3\rightarrow \overset{-}{H}CO_3$, gives the value 3750 cal. at room-temperature, a figure lower than Thomsen's (4200 cal.) and Walker, Bray, and Johnston (5360 cal.). A discrepancy in the opposite sense occurs for the heat of the first ionisation constant of carbonic acid, $CO_2+H_2O\rightarrow\overset{+}{H}+H\overset{-}{C}O_3$. H. H. Ho.

3686. Heat of Dissociation of the Cadmium Molecule by Thermo-Optical Methods. H. Kuhn and S. Arrhenius. *Zeits. f. Physik*, 82. 11–12. *pp.* 716–722, *May* 30, 1933.—The decrease in absorption of cadmium vapour with increasing temperature provides a means of estimating the heat of dissociation of the cadmium molecule, Cd_2. Numerically this has been found to be $2\cdot 0\pm 0\cdot 5$ k.cal. in very good agreement with the value deduced by the theory of London from the dispersion f values for D_{Cd_2}/D_{Hg_2}. The continuous absorption of cadmium is similar to mercury in showing sometimes a positive temperature coefficient. The course of the temperature coefficient in the neighbourhood of the intercombination line at 3261 Å is discussed. W. R. A.

3687. Heat of Dissociation of the Carbon-Carbon Linkage. J. B. Conant. *J. Chem. Phys.* 1. *pp.* 427–431, *July,* 1933.—Ziegler's colorimetric measurements of the dissociation of hexaphenylethane provide information in regard to ΔF and ΔH for this process in solution. Assuming that ΔS for the dissociation of other similar compounds is approximately the same and independent of the temperature (over a short range), ΔF and ΔH of dissociation of a variety of compounds have been calculated from published data. It is suggested that the effects of substitution are approximately additive. There is evidence to indicate that the heat of activation of the association reaction of free radicals is very low; if this is the case the heats of dissociation estimated from the calculations of this paper provide information in regard to the heat of activation of the dissociation reaction. AUTHOR.

3688. Transport of Ions by the Explosion-Wave. A. E. Malinowski and K. T. Tkatschenko. *Phys. Zeits. d. Sowjetunion,* 3. 5. *pp.* 529–536, 1933. *In German.*—The paper describes experiments on the transport of ions in the explosion of a definite mixture of acetylene and air, and forms part of a series of investigations on the mechanism of the combustion process and the explosion of gas mixtures [see Abstract 2361 (1930)]. The apparatus used consisted of a glass tube of about 2 cm. internal diameter and 60 cm. long through which the explosion gas mixture was driven at constant pressure, the mixture being ignited at the open end of the tube, at which the gas mixture passed into the air. The tube contained two similar cylindrical condensers whose distance apart could be varied. Each condenser was in circuit with a ballistic galvanometer and a battery. A voltage of from 250 to 1400 volts could be applied to the condensers. When the explosion wave travelled down the tube in the opposite direction to the gas current, a conduction current was observed in the galvanometers. The number of ions caught could be estimated from the galvanometer deflection. Calling the condenser and galvonometer nearer the ignition point of the mixture No. 1, and the other No. 2, it was found that galvanometer No. 2 gave a smaller deflection when the field was applied to condensers Nos. 1 and 2, than when no field was applied. The ion transport is measured by the difference in the deflections of galvanometer No. 2 in the two cases. A diagram of the apparatus, with tables of results, are given, together with a short discussion. T. B.

3689. Burning of an Acetylene-Air Mixture in a Magnetic Field. A. E. Malinowski, W. S. Rossichin and B. I. Naugolnikow. *Phys. Zeits. d. Sowjetunion,* 3. 5. *pp.* 537–541, 1933. *In German.*—J. J. Thomson has suggested that besides atoms and molecules, electrons must take part in the process of burning. This has been experimentally proved by Malinowski, who sudied the effect of an electric field on burning. Experiments, however, on the effect of a magnetic field failed to show any positive result. This the authors explain as due to the magnetic field not having been of sufficient strength and they describe experiments made with field strength of about 40,000 gauss. The results are negative.

This is accounted for by a simple calculation which shows that 56,000 gauss are necessary for the effect to be observable. T. B.

3690. Mechanism of the Inflammation of Electrolytic Gas. N. Semenoff, A. Nalbandjan and F. Dobowizky. *Faraday Soc., Trans.* 29. *pp.* 606–610, *May,* 1933.—Further experiments to decide whether this is a chain reaction. A. S. C. L.

3691. Spontaneous Ignition Temperatures of Mixtures of Hydrogen and Air as a Function of the Rate of Heating. M. Prettre. *Comptes Rendus,* 196. *pp.* 1891–1893, *June* 19, 1933.—Previous work is continued [see Abstract 2010 (1929)] and it is concluded that the spontaneous ignition of mixtures of hydrogen and air at atmospheric pressure takes place at temperatures which are depressed according as oxidation reactions are avoided during the heating period. Divergences of the present data from those of Hinshelwood are explained. H. H. Ho.

3692. Transformation of *o*- into *p*-Hydrogen in the Solid Condition. E. Cremer and M. Polanyi. *Zeits. f. phys. Chem.* 21. *Abt. B.* 5–6. *pp.* 459–468, *June,* 1933.—Determining the relative concentrations by the heat conductivity method the velocities of transformation of *o*- into *p*-hydrogen, k ($= 10^5 x^2 \cdot \Delta x/\Delta t$, where x is percentage of *o*-hydrogen, and t time) in the solid (at 4–12° Abs.) and liquid at (14–20° Abs.) states are respectively 19 and 12 ; and in both cases independent of temperature. The reaction is of the second order, and results from the mutual action of two molecules of *o*-hydrogen. The mechanism is discussed, leading to the conclusion that there is no " tunnel-effect," but that the transformation results solely from the forces brought into play by the near contact of the two molecules. The decrease in k for solid hydrogen towards the end of the change is due to hindrance to mutual approach of the few remaining molecules of *o*-hydrogen caused by the larger amount of *p*-hydrogen. C. A. S.

3693. Activation Energies for Reactions of Atoms in Different States. G. K. Rollefson and J. C. Potts. *J. Chem. Phys.* 1. *pp.* 400–401, *June,* 1933.—A slight modification of Eyring's method enables the activation energy for the reaction of iodine monochloride with normal or with excited chlorine atoms to be calculated. The calculations indicate that normal chlorine atoms are much more reactive with respect to iodine chloride than are chlorine atoms excited to the $^2P_{\frac{1}{2}}$ state. Experimental evidence supporting these calculations is obtained from the results of Rollefson and Lindquist with mixtures of hydrogen, chlorine and iodine monochloride. In the modified method, the atomic interactions—which give rise to the activation energy—are obtained from the potential energies of those molecular states which may be adiabatically formed from atoms in the particular electronic states to be considered. AUTHORS.

See also Abstracts 3664, 3704, 3705.

THERMODYNAMICS.

3694. Planck's Proof of the Second Law of Thermodynamics. M. Sugita. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 108–113, *March,* 1933. *In German.*—Discusses the second law of thermodynamics, particularly in its application to systems with several degrees of freedom. J. H. A.

3695. Multiple Entropy and the Two Fundamental Laws of Thermodynamics. A. Press. *Phys. Zeits. d. Sowjetunion*, 3. 5. *pp*. 487–506, 1933. *In English*.—A generalised form of the first law of thermodynamics is given and its advantages are discussed. The generalised equation obtained is integrated by means of an integrating factor μ, an infinite number of equations $p = p(v, \mu) \equiv p(v, t)$ resulting only one of which enjoys the property of truly representing the equation of state. The significance of the remainder of the type $p = p(v, \mu)$ is that for $\mu =$ constant such working loci transform into straight lines in a properly chosen (v, ϕ) plane with ϕ as a generalised or multiple entropy concept. The thermodynamic potential function $(E - \phi/\mu)$ is developed from a generalised standpoint and it is shown that in any process limited by the constraint $\mu =$ constant, the mechanical work done externally depends upon its initial and final values. G. G. S.

3696. Equation of State of Real Fluid. S. C. Bradford. *Engineering*, 135. *p*. 439, *April* 21, 1933.—The author has previously shown [see Abstract 4057 (1930)] that the temperature movements of liquid particles are not the same as those of gas particles, and that the Maxwell-Boltzman equation must contain a term λ which expresses the ratio of the most probable speed in the liquid to that in a perfect gas. An equation is now developed, $(p + K)(v - b)A = \lambda^2RT$, which differs from the original equation of van der Waals in containing λ and also an association factor A. Using Edser's law of force this leads to another expression which is the equation of state of a real fluid. When this formula is applied to the vapour pressure of liquids, it is found that the term b, instead of varying as much as 25 or 100 %, is constant to within a few per cent. This is shown to confirm the prediction of Richards that the nearest distances of approach of the centres of elastic molecules in collision must decrease as the energy of the collisions increases. Also that the conception that molecules behave as attracting elastic spheres is remarkably in accordance with the observed properties of matter. T. B.

3697. Calculation of the Second Virial Coefficient of Gases. T. S. Wheeler. *Indian Journ. Phys.* 7. *pp*. 595–601, *April* 20, 1933. *In English*.—The approximate equation for the second virial coefficient B of a gas consisting of small spherically symmetrical particles, obtained by the author in a previous paper [see Abstract 2921 (1932)] is

$$B = C_1(\lambda/T)^{3/(n-1)} + C_2(\mu/T)^{3/(m-1)}$$

where λ/r^n is the repulsive force and μ/r^m is the attractive force between two particles at distance r, C_1 and C_2 are constants and T is the absolute temperature. The relations involved between this equation and the equation of Lennard-Jones connecting the same quantities are given. The greatest change necessary in any of Lennard-Jones' values of λ and μ to obtain correspondence between the equations is about 20 % which involves a change of only 2 % in the " generalised diameter." G. G. S.

3698. Empirical Equation of State for Gases. G. A. Linhart. *J. Phys. Chem.* 37. *pp*. 645–653, *May*, 1933.—The equation $\frac{1}{V_P} = \frac{kP^K}{1 + kP^K} \cdot \frac{1}{V_\infty}$ where P and V are the simultaneous pressure and volume of a gas, and k, K are approximately constant, is shown to represent adequately the behaviour of gases. K is a function of temperature which approaches unity at high temperatures. J. P. A.

3699. Thermodynamic Properties of Real Gases as Explicit Functions of the Pressure and Temperature. T. C. Huang and K. C. Su. *Tsing Hua Univ., Sci. Reports*, 2. *pp.* 37–48, *April*, 1933. *In English.*—By means of a method of repeated substitution, several theoretical equations of state have been transformed from the form $p = F(v, T)$ to the form $V = f(p, T)$, and from the results of transformation an equation which generalises all the equations of state in terms of pressure and temperature as independent variables has been deduced. Some general equations for the thermodynamic properties of real gases in terms of pressure and temperature as independent variables are also obtained. G. G. S.

3700. Nature of the Critical States at the Transition Liquid-Gas. W. Ostwald. *Kolloid Zeits.* 64. *pp.* 50–62, *July*, 1933.—It is found that between liquids and gases there is not only the homogeneous transition (above the critical temperature and pressure) and the heterogeneous transition (below the critical points) but also a disperse transition, which is manifest in a most pronounced and stable form in the critical zone. For explanation, combinations of liquids and gases are described as made up of two non-miscible systems, viz. gases in liquids: gas-liquidosoles, foams; and liquids in gases: aerosoles, mists; these can only be mixed by structure destruction, and therefore can co-exist for long periods of time. The transition is therefore: liquid $\rightleftarrows$ [liquidosol $\rightleftarrows$ foam] $\rightleftarrows$ [mist $\rightleftarrows$ aerosol] $\rightleftarrows$ gas, and in addition to a vapour pressure there is an atomisation pressure, whilst electrical charges and complications are to be expected. Anomalies in the critical zone are explained by making use of the properties of the above phase constituents, *e.g.*, formation of a middle-layer by condensation in the critical zone, which exhibits abnormally great viscosity or elasticity, depends upon development of the foam and sedimentation of the mist. Deviations from the Hagen-Poiseuille law are explained, as also the existence of labile irreversible states. H. H. Ho.

3701. Entropy in Intermediate Phases. A. Ölander. *Zeits. f. phys. Chem.* 165. *Abt.A.* 1–2. *pp.* 65–78, *June*, 1933.—The intermediate phases are discussed. Those which have an extended range of existence are either regular or irregular. In the former, the variation in composition could take place in two different ways. Formulæ are developed for the partial molar entropy of such compounds and are compared with the experimental results. These magnitudes were measured as the temperature coefficients of the electrode potentials of alloys, if they belonged to this species of compound. F. J. B.

3702. Entropy of a Crystalline Solution of Silver Bromide and Silver Chloride in Relation to the Third Law of Thermodynamics. E. D. Eastman and R. T. Milner. *J. Chem. Phys.* 1. *pp.* 444–456, *July*, 1933.—With the object of testing experimentally the third law of thermodynamics as applied to crystalline solutions, the chief thermodynamic properties of such a solution of AgBr and AgCl have been studied. Measurements described and recorded include: the free energy of formation, obtained from measurements of the e.m.f. of appropriate silver-silver halide electrodes against hydrogen ; the heat of formation, from measurements of heat absorbed in dissolving the various phases in a thiosulphate solution; the specific heats between 15° K. and 298° K. of the pure constituents and the solid solution. The entropy of AgBr and of AgCl is calculated from the specific heat curves. The entropy change in the formation of the solid solution at 298° K. is calculated from the experimental data and is found to agree with the result calculated statistically. The latter is identical in form and magnitude with the entropy as calculated thermodynamically for an ideal solution, though the heat content and free energy show that the solution is far from perfect. From the specific heat curves it appears that the entropy of mixing persists essentially unchanged in magnitude to the lowest temperature of the measurements, and presumably to the absolute zero. The existence of finite entropies, or entropy differences, at the absolute zero is regarded as established thermodynamically, and the requisite interpretation of statistical ideas to secure concordance with this result is discussed. Finally, although the existence of a valid but limited third law is accepted, and a concise general statement of it suggested, it is pointed out that the " principle of the unattainability of the absolute zero " must be regarded as extra-thermodynamic in character. AUTHORS.

3703. Free Energy of Ozone. L. S. Kassel. *J. Chem. Phys.* 1. *pp.* 414–417, *June,* 1933.—The infra-red spectrum of ozone is discussed. Gerhard's three fundamental frequencies, 528 cm.$^{-1}$, 1033 cm.$^{-1}$, and 1355 cm.$^{-1}$ are shown to be in somewhat imperfect agreement with experiment. They are nevertheless sufficiently reliable to justify a spectroscopic calculation of the free energy of ozone, in view of the unreliability of the experimental data. Ozone is found to be much less stable than experiment had shown ; $S_{298 \cdot 1} = 57 \cdot 0$ cal./deg./mole, as compared with $S_{273} = 86 \cdot 5$ based on e.m.f. measurement. The maximum partial pressure of O_3 in an equilibrium mixture of O, O_2, and O_3 at a total pressure of 1 atm. is $1 \cdot 0 \times 10^{-6}$ atm. at 3400° K. The 1 % ozone obtained by heating filaments to 2300° K. in liquid oxygen must have been formed in the cold regions from atomic oxygen. AUTHOR.

3704. Thermodynamic Data for Metallic Sulphates. Parts I and II. F. Ishikawa and T. Murooka. *Tohoku Univ., Sci. Reports,* 22. *pp.* 131–155, *March,* 1933. *In English.*—Attempts were made to determine the thermodynamic data, free energy of formation, entropy, and heat of formation of metallic sulphates which do not form hydrates, that is, sulphates of mercurous mercury, lead, thallium and silver. The method of investigation was based upon the measurements of the e.m.f. of reversible cells containing the salts in question. The method was extended to the sulphates of copper, cadmium and zinc which form hydrates. The vapour pressure of the hydrates and of the saturated solutions of these salts were also determined. F. J. B.

3705. Thermodynamic Studies on Potassium and Sodium Sulphates. F. L. E. Shibata, S. Oda and S. Furukawa. *Hiroshimà. Journ. Sci.* 3. *pp.* 227–242, *March,* 1933. *In English.*—The e.m.f.s of cells of the type M_2SO_4, H_2SO_4/Hg, where M is sodium or potassium, with and without crystals present, have been determined at a number of temperatures between 20° and 37° C., and the temperature coefficients calculated. The results have been employed for calculation of the entropies and heats of formation and dissolution of the two sulphates. H. F. G.

3706. Thermodynamical Study of Systems of Type $PbCl_2$—RCl—H_2O at 25° C. A. J. Allmand and L. J. Burrage. *Faraday Soc. Trans.* 29. *pp.* 679–689, *June,* 1933.—The final results of an electrometric study of the system $PbCl_2$—KCl—H_2O at 25° C. are described, and discussed in the light of revised analytical data. The general nature of the isodynes of the three components of the system is elucidated. Unexpected and anomalous activity relations have been found in the same concentration region which presented difficulties when the original analytical work was carried out on the system. AUTHORS.

3707. Thermodynamics of Aqueous Hydrochloric Acid Solutions from E.M.F. Measurements. H. S. Harned and R. W. Ehlers. *Am. Chem. Soc., J.* 55. *pp.* 2179–2193, *June,* 1933.—Accurate measurements of the cell H_2 / HCl(m) / AgCl / Ag from 0° to 60° at 5° temperature intervals have been made. The standard potential of the silver-silver chloride electrode from 0° to 60° has been evaluated. Equations which give the e.m.f.s as a function of the temperature have been obtained by the method of least squares. An equation has been formed by means of which the activity coefficient of hydrochloric acid in water, γ, may be computed from 0° to 60° through the concentration range of 0 to 4 M with a very high accuracy. By differentiation of this equation, the relative partial molal heat content of the acid was computed from 0° to 60° and from 0 to 4 M. Good agreement was obtained with calorimetric data. From the heat content data, the relative partial molal specific heat has been computed through the wide concentration and temperature ranges under consideration. Good agreement is found with the calorimetric data. The temperature coefficient of the relative partial molal specific heat has been roughly evaluated. AUTHORS.

3708. Van't Hoff's Equation for Chemical Equilibrium and the Equation of the Isochore of Reaction. E. Denina. *N. Cimento,* 10. *pp.* 108–117, *March,* 1933.—The thermodynamic significance of van't Hoff's equation expressing the influence of temperature on chemical equilibrium is defined. The errors contained in the demonstration of this equation given by Nernst and in a number of treatises are rectified, and the impropriety of the name " isochore of reaction " is indicated. T. H. P.

3709. Thermodynamics and the Kinetics of Gaseous Reactions. W. H. Rodebush. *J. Chem. Phys.* 1. *pp.* 440–443, *July,* 1933.—The free energy change of a reaction mechanism gives no information concerning the rate of the reaction, which depends, not only on the heat of activation, but on certain additional terms analogous to entropies. On the assumption that the energy of activation is required in the form of an unstable complex, the reaction becomes more rapid as the number of possible states for such complex increases. The complete equation for both heat and entropy of activation may be regarded as defining a free energy of activation. The aptness of these thermodynamic analogies is shown by consideration of the homogeneous bimolecular condensation of two unlike atoms to form a diatomic molecule. The theory of unimolecular reactions [see Abstract 1688 (1923)] and that of bimolecular reactions are discussed on these lines. T. H. P.

See also Abstracts 3379, 3664.

VAPOUR PRESSURE.

3710. Empirical Formulæ for the Relation between the Temperature and Pressure of Saturated Vapour. A. Adamson. *Manchester Phil. Soc., Mem.* 76. *pp.* 1–9, 1931–1932.—By means of

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successive applications of the formula $(\log p - \log p_1)/(\log p_2 - \log p) = r$ (where p, p_1 and p_2 represent the saturation water vapour pressures at temperatures t, $(t - 10)$ and $(t + 10)$° C. respectively, and $r = 1{\cdot}1144 - 0{\cdot}001\sqrt{18{\cdot}6t + 775}$) and the assumption that when $t = 100$° C., $p = 760$ mm. and $p_1 = 525{\cdot}76$ mm., values are obtained which agree with the experimental results of Holborn and Henning to within 0·05 % from 10° C. to 100° C., and within 0·5 % up to 350° C. The empirical relation $(a - \log p)(c + t) = b$ can also be applied to water vapour if a, b and c are determined over each range of 20° C. By application of Dühring's law these formulæ may be extended to other substances. The constants of the equation are tabulated for water, ethyl alcohol, methyl alcohol, ethyl ether, naphthalene and mercury over specified temperature ranges. R. W. P.

3711. Simple Method for Accurate Determinations of Vapour Pressures of Solutions. D. A. Sinclair. *J. Phys. Chem.* 37. *pp.* 495–504, *April*, 1933.—A method is used which is a modification of the isopiestic method of Bousfield [see Abstract 572 (1924)] in which four open cylindrical glass vessels containing different solutions are placed in a desiccator vessel, which is evacuated in a thermostat for two or three days. During this time the solutions are assumed to have come into equilibrium by distillation of water, so that each has the same vapour pressure. The concentrations are then determined by weight, and hence, if accurate data are available for one solution, equally accurate values may be assigned to the others. It is pointed out that equilibrium in this procedure may in some cases take years to attain, and the method is improved by providing good metallic conduction between the solutions, by efficient stirring, and by making the solutions shallow. Results are given for solutions of sucrose, sodium chloride, and potassium toluene-p-sulphonate, using potassium chloride as standard. T. B.

3712. Molecular Weight of Substances in Solution in Liquid Ammonia at Room-Temperature. A. I. Schattenstein and A. M. Monossohn. *Zeits. f. phys. Chem.* 165. *Abt.A.* 1–2. *pp.* 147–153, *June*, 1933.—A description is given of a differential manometer for the measurement of vapour pressures of solutions in liquefied gases. This apparatus is used to determine the molecular weights of urea, grape sugar, quinhydrone, ammonium chloride and ammonium nitrate in liquid ammonia at 10° C. The limit of error is estimated at 3 %. Comparison of the results for urea with those obtained by other workers at other temperatures indicates that the degree of association of this substance in liquid ammonia does not vary appreciably with temperature. In the range of concentrations investigated ammonium nitrate and grape sugar are found to have the normal molecular weight. Quinhydrone appears to be completely dissociated into quinone and quinol, while ammonium chloride is associated. L. A. W.

See also Abstracts 3463, 3704.

ACOUSTICS.

3713. Ultrasonic Waves. Part II. P. Biquard. *Rev. d'Acoustique*, 1. *pp*. 315–335, *Sept.–Nov.*, 1932.—In this entirely mathematical paper, as in a previous one [see Abstract 312 (1933)], the author derives useful relations and proceeds to apply them to problems in ultrasonics. He is here mainly concerned with the concept of velocity potential and its application (i) to the determination of the disturbance produced at right angles to its surface by a plane emitter, and (ii) to radiation from a circular source (derivation of the formula $\sin\theta = 1{\cdot}22\lambda/D$). E. J. I.

3714. Supersonic Interferometer and Absorption Measurements. W. D. Hershberger. *Acoustical Soc. of America, J*. 4. *pp*. 273–283, *April*, 1933.—The previously developed theory of the supersonic interferometer [see Abstract 1311 (1932)] is extended with the particular view of utilising it for absorption measurements in gases. It is shown that the mechanical impedance of the interferometer is $Z = Z_0 + Z(l)$ where $Z_0 = j(m\omega - s/\omega) + r$; $Z(l) = Ac\rho/\tanh 2al + (Ac\rho/\sinh 2al)e^{j}$ and

$$\theta = -\operatorname{arc\ tan} \frac{\sin 2kl \sinh 2al}{\cos 2kl \cosh 2al - 1}.$$

That is, if reactance is plotted against resistance an impedance spiral is obtained with centre ($Ac\rho/\tanh 2al$, 0) and radius $Ac\rho/\sinh 2al$. The action of the interferometer is studied in terms of the properties of the spiral. Absorption measurements are effected by compensating for the changes in the equivalent series electrical resistance because of changes in l by adjusting a shunt resistance across the crystal so the e.m.f. is held constant, irrespective of l. Absorption in the medium is calculated from the values of shunt resistance for the path lengths of interest. Measurements were taken at three frequencies in the range 899·0 kc to 2514 kc. The quantity $2a\lambda^2$ as measured by the interferometric method is not constant but shows a systematic change with frequency. AUTHOR.

3715. Sound Absorption in Non-Reactive Gas Mixtures. R. Lawlor. *Acoustical Soc. of America, J*. 4. *pp*. 284–287, *April*, 1933.—Abello's results (see Abstract 238 (1929)] for binary gas mixtures may be derived simply if it is assumed that the gases mixed are non-reactive. It is found that if any number of non-reactive gases are mixed, the attenuation constant of the mixture is a linear homogeneous function of the volume percentages of the components. Values of the absorption coefficients of CO_2, N_2O, H_2, He, A, and N_2 at 612 kc. are calculated. AUTHOR.

3716. Decomposition of Complex Molecules by Means of Supersonic Waves. A. Szalay. *Zeits. f. phys. Chem.* 164. *Abt.A*. 3–4. *pp*. 234–240, *April*, 1933.—Complex molecules such as those of starch, gum arabic, and gelatin, decompose when subjected to intense ultrasonic waves (722,000 ∼) ; the reactions are evidenced by the reduction of viscosity, and, in the case of starch, by colorimetric measurements with starch-iodine mixtures. Decomposition proceeds also, but more slowly, in the case of simpler molecules, *e.g.*, monosaccharides are formed from sucrose, and paraformaldehyde and hexamethylenetetramine are decomposed to a smaller degree. On the other hand, no reaction could be observed in the case of paraldehyde, diphenylether, and other relatively simple compounds. H. F. G.

3717. Auditorium Acoustics. J. Brillouin. *Rev. d'Acoustique,* 1. *pp.* 262–279, *Sept.–Nov.,* 1932.—The equations of reverberation are deduced assuming a uniform distribution of sound energy whereas, on account of reflections from walls, the growth and decay of energy at any point in a room are discontinuous functions of time. The author discusses the effect of this on audition and recommends the use of acoustical reflectors to concentrate energy on the (highly absorbing) audience and thus reduce wall reflection. In this manner not only the intensity but the quality of audition is augmented. The author concludes with recommendations on the correction of existing halls and the pre-construction study of proposed halls. E. J. I.

3718. Absorption of Sound by Porous Materials. H. L. Penman and E. G. Richardson. *Acoustical Soc. of America, J.* 4. *pp.* 322–330, *April,* 1933.—An experimental test of the Rayleigh theory of sound absorption in porous materials is described. The experimental results support the theory as regards variation of absorption with frequency, but the damping is greater in practice than in the theory. G. G. S.

3719. Application of Kennelly's Method to Electrodynamic Loud-Speakers. G. le Guen. *Rev. d'Acoustique,* 1. *pp.* 336–366, *Sept.–Nov.,* 1932.—Having described an electrodynamic loud speaker due to Guéritot (Gaumont 1922), the author proceeds to study its properties in conjunction with Kennelly diagrams. The mode of formation and solution of the electrical and the mechanical differential equations describing the behaviour of the loud speaker is indicated and the constants involved are studied in detail. Kennelly's method is described and a diagram showing the results obtained with the loud speaker is given ; this diagram is naturally a complicated one on account of the various coupled systems involved. E. J. I.

3720. Classification of Microphones. A. Charkewitsch. *E. N. T.* 10. *pp.* 195–198, *May,* 1933.—A systematic but brief discussion of the acoustical, mechanical and electrical characteristics of all known types of microphone. It is considered that the five main types cover all desirable or practically possible combinations at the present time. Details of no particular microphone are given, but they could be found from the references and the results are summarised symbolically in a table. W. H. Ge.

3721. Analysis and Study of Machine Noises. J. F. Bouscasse. *Rev. d'Acoustique,* 1. *pp.* 296–314, *Sept.–Nov.,* 1932.—The author distinguishes between unpitched " background noise " due to rubbing of rotating parts, and " musical noise " whose pitch, save for resonant vibrations, depends upon the speed of rotation and is due to vibration or rotation of machine parts and to periodic impulses. The paper is concerned with noise of the latter kind and for its analysis an apparatus of the microphone (or oscillator), amplifier, filter, and milliammeter type is described. Details of the calibration of the components are given and the method consists in substituting the oscillator for the microphone and adjusting its output until the milliammeter reading attains the value registered when the microphone was in circuit and exposed to the sound. Examples of particular analyses are given, the origin of the component notes is explained, and methods for their diminution are suggested. For low-power machines the microphone is placed near the machine and the whole is surrounded by sound absorbents. E. J. I.

3722. Minimum Audible Sound Fields. L. J. Sivian and S. D. White. *Acoustical Soc. of America, J.* 4. *pp.* 288–321, *April,* 1933.—The minimum audible field (M.A.F.) has been determined from data taken on 14 ears over the frequency range from 100 to 15,000 c.p.s. The observer is placed in a sound field which is substantially that of a plane progressive wave, facing the source and listening monaurally. The M.A.F. is expressed as the intensity of the free field, measured prior to the insertion of the observer. Similar data are presented for binaural hearing, over the range from 60 to 15,000 c.p.s., obtained with 13 observers. At 1000 c.p.s. the average M.A.F. observed is $1\cdot9\times10^{-16}$ watt per cm.^{2}, corresponding to a pressure 71 db below 1 bar. Included are data showing how the M.A.F. varies with the observer's azimuth relative to the wave front. Another type of threshold data refers to minimum audible pressures (M.A.P.) as measured at the observer's ear drum. The differences obviously to be expected between M.A.F. and M.A.P. values are due to wave motion in the ear canal and to diffraction caused by the head. The M.A.F. data are discussed in relation to the M.A.P. determinations from several sources. Some possible causes of difference between the two, which are due to experimental procedure and may add to the causes already mentioned, are pointed out. AUTHORS.

3723. Tuning-Fork Audiometer. E. Z. Stowell. *Acoustical Soc. of America, J.* 4. *pp.* 344–352, *April,* 1933.—A fork of frequency 512 was mounted on a steel block, and the block on a flat plate which carried a hammer actuated by a trigger, a stop-watch, the long hand of which moved round a scale of decibels instead of seconds, and a lens for observing the decay of the vibrations of the fork. In testing the instrument, which weighs about 1 lb., the sounds of a loud-speaker were adjusted to give equal acoustic pressures at different frequencies, and the loudness as measured by the audiometer was fairly constant except for frequencies in the neighbourhood of 512. The instrument was used for a 5-hour series of observations of traffic noises, and it is concluded that the fork audiometer is a satisfactory instrument for this purpose from the point of view of both cost and portability. G. E. A.

3724. Two Integral Laws of Hearing. Intensity and Time of Audition of a Sound Impulse. S. Lifschitz. *Zeits. f. Physik,* 83. 1–2. *pp.* 123–128, *June* 6, 1933. *Acoustical Soc. of America, J.* 5. *pp.* 31–33, *July,* 1933.—A telephone circuit was made and broken at different rates up to 463 contacts per second, and by a rotating device the number of contacts simultaneously made or broken could be increased up to 16. A second telephone connected to an audiometer measured the intensity of the sound impulses in decibels. The measurements show that the loudness L is connected with the intensity of the impulse I by the equation: $L = \log(IN)$, where N is the number of single impulses. If I is a continuous function, $L = \log\int_{t_1}^{t_2} I\,dt$. With a modification of the experiment it is found that the subjective time of audition changes with the intensity of the sound and does not coincide with the objective duration of the sound, and that the time of audition, D, is given by $D = \log IN$. For continuous I, $D = \int_{t_1}^{t_2} \log I \, dt$. In applying the last result to musical performances, it is concluded that the time of audition, as dependent on reverberation, must always be constant if the optimum effect is to be attained. G. E. A.

3725. Acoustical Properties of the Japanese Wind Instrument, Syakuhati. J. Obata and T. Tesima. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 125–134, *March*, 1933. *In English. Imp. Acad. Tokyo, Proc.* 9. *pp.* 149–151, *April*, 1933. *In English.*—In continuing the investigation of this instrument [see Abstract 1606 (1931)] the syakuhati was blown artificially by compressed air, and the directional properties of the sound and the relation between tone-colour and blowing pressure were investigated. A condenser microphone and a Siemens stabmikrophon were employed to record the sound waves and to measure their intensity. The amplitudes of components were determined by analysing the recorded sound waves. Sounds are emitted from both ends of the instrument and these sounds have phases which are either the same or opposite. The tone-colour at points in a plane containing the instrument varies with the orientation of the instrument. The *ro* and *ti* tones have respective frequencies 290 and 437, and the *ti* tone is produced by opening the three lateral holes. The directional properties of these tones are illustrated by polar curves of the fundamental and second and third harmonics of each. With a pressure of 3·45 cm. of water, the fundamental of the *ro* tone has an intensity of about a tenth of that of the second harmonic. When the pressure is increased to 3·75 cm., the note changes from the fundamental to the second harmonic and all the odd harmonics disappear. G. E. A.

3726. Component Tones from a Bell. A. T. Jones and G. W. Alderman. *Acoustical Soc. of America, J.* 4. *pp.* 331–343, *April*, 1933.—The gravest sixteen partials of three bells (weights 900 kg., 675 kg., 464 kg.) have been examined by the method described by Tyzzer [see Abstract 4067 (1930)]. The numbers of nodal meridians and nodal circles found for the partials of these bells agree with those found on three smaller bells by Tyzzer, except that some additional circles are now found in the upper parts of the bells. The levels at which nodal circles are found are given. The relative frequencies of certain modes of vibration of the bells now studied are compared with those for the corresponding modes of a thin ring. Various reasons are adduced for believing that the vibrations of bells have a considerably larger compressional component than has usually been supposed. Oscillograms have been obtained from which the amplitudes of the partials have been calculated. When a bell is struck in the usual manner the most prominent partial at first is the fifth. In less than half a second—on the bells investigated—the fifth has yielded to the third, which is the most prominent until about four seconds after the stroke. After that the first partial is the most prominent. An Appendix gives an approximate method of correcting for the beats with which some partials are effected. AUTHORS.

See also Abstract 3498.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 3312, 3841, 3856.

CONDUCTION AND DISCHARGE IN GASES.

3727. Theory of Glow Discharge. W. Rogowski. *Zeits. f. Physik*, 82. 7–8. *pp.* 473–488, *May* 15, 1933.—A theoretical discussion is given as to whether the extreme postulate of Compton and Morse [see Abstract 161 (1928)] or the combination of ionisation and space-charge equations furnishes the most suitable basis for theoretical treatment of glow-discharge phenomena. The conclusion is reached that although the work of Compton and Morse has done much to explain glow-discharge phenomena, the extreme postulate does not appear to be valid. A. W.

3728. Mechanism of the Liberation of Electrons at the Kathode Spot of an Arc Discharge. F. Lüdi. *Zeits. f. Physik*, 82. 11–12. *pp.* 815–832, *May* 30, 1933.—The various theories hitherto advanced regarding the liberation of electrons at the kathode spot of an arc discharge, are discussed and it is shown that they will not bear rigorous investigation. Research is then described in support of the view that the explanation of the liberation of electrons is to be found in impacts of the second kind of multiply charged positive ions. A. W.

3729. Corona Currents in Electro-Filters. W. Deutsch. *Phys. Zeits.* 34. *pp.* 448–453, *June* 1, 1933.—A continuation of work previously described [see Abstract 2531 (1933)]. The theory previously given is here applied to the solution of a problem of fundamental importance for understanding the phenomena which occur in the so-called electro-filters. The formulæ obtained are shown to give results in good agreement with those actually obtained with one of these filters. A. W.

3730. Unipolar Form of Surface Corona. A. Coehn and W. Ziegler. *Zeits. f. techn. Physik*, 14. 6. *pp.* 246–249, 1933.—A method of examining the surface corona from 200 V upwards is described. Up to potentials of 800 V the discharge occurs only at the positive pole, but at higher voltages it becomes bipolar. Using Gemant's method, the effect of the porous nature of the insulating material was studied and photographs of the discharge across the surface of the dielectric and the electrodes were obtained. F. C. C.

3731. H.F. Discharge in Gases. T. V. Ionescu and Irène Mihul. *Comptes Rendus*, 196. *pp.* 1292–1294, *May* 1, 1933.—Study of h.f. discharges has shown that the potential necessary to maintain the discharge passes through a minimum value for frequencies of the order of 10^8 p.p.s. and pressures of the order of 10^{-2} mm. of Hg. It has also been found that the electrons in ionised gases have a natural frequency of the order of 10^8 p.p.s. Electric fields of such frequencies can impart to these electrons energy greater than is necessary to ionise the gas and thus the discharge is maintained. Experiments are described in which the gas was contained in a tube 5 cm. diameter and 20 cm. long, two tin-foil electrodes being fastened on opposite sides of the tube and connected to a Mesny oscillator. An axial magnetic field was produced by means of two coils arranged in the Helmholtz manner. The wave-lengths used were from 4·7 to 8·7 m. and the gas pressures ranged from a few thousandths to a few tenths of a mm. of Hg. Two régimes were observed. In the first, gradual increase of the magnetic field for low gas pressures caused the light to grow slowly at first and finally disappear completely for $H = 22$ gauss and $\lambda = 4 \cdot 7$ m., and for $H = 12$ gauss and $\lambda = 8 \cdot 7$ m. For greater pressures the light decreased slowly and disappeared for the same values of the field. On exceeding these values the light increases rapidly up to a value ten times greater than without the magnetic field. The values of the magnetic field for which the light diminishes rapidly (22 gauss at 4·7 m. and 12 gauss at 8·7 m.) are those for which the free electrons are in resonance with the external electric field. In the second régime, even when the h.f. electric field is stronger, the characteristic variations found in the first régime are not observed on passing through values of the magnetic field corresponding to resonance. In this stage the observed effects indicate that the electrons are not free. A. W.

3732. Ignition Conditions of Low-Voltage Arcs and Grid-Controlled Low-Voltage Arcs. F. Klaiber. *Phys. Zeits.* 34. *pp.* 441–447, *June* 1, 1933.—The main points of the theory of the ignition of grid-controlled and ordinary low-voltage arcs are outlined and the ignition conditions are given. A number of conclusions, applicable to grid-controlled low-voltage arcs, are drawn. The relation between the slope of the ignition characteristic and the high-vacuum controllance is explained and the dependence of the ignition characteristic on the pressure and temperature is discussed. Complete and partial ignition are contrasted and their effects discussed. A. W.

3733. Excitation Potential of the λ2883 and λ2895 Bands of CO_2. A. S. Roy and O. S. Duffendack. *Nat. Acad. Sci., Proc.* 19. *pp.* 497–503, *May*, 1933.—The authors studied the conditions under which the bands λ2883 and λ2895 appear in the spectrum of the low voltage arc in mixtures containing an excess of oxygen and traces of carbon monoxide or carbon. It was found that the bands in question behave quite differently from the other CO_2 bands when excited in mixtures of oxygen. They are always strongly excited when the conditions are such that the negative bands of CO and N_2 and the ultra-violet bands of oxygen are excited, and it is therefore concluded that their excitation potential must be near to 19 volts. Assuming the bands to arise from the CO_2 ion which is generated from neutral CO_2 and excited in a single act, the excitation potential should equal the sum of the ionisation potential of CO_2 plus the voltage corresponding to the bands themselves, *i.e.*, $14 \cdot 4 + 4 \cdot 3 = 18 \cdot 7$ volts. Other evidence shows that excited oxygen ions O_2^+ carry enough energy to ionise and excite a CO_2 molecule in a collision of the second kind, in accordance with the equation:

$$\underset{(18 \cdot 3 \text{ to } 19 \cdot 4)}{O_2^{+1}} + CO_2 \rightarrow \underset{(18 \cdot 7)}{CO_2^{+1}} + O_2$$

W. S. S.

3734. Quantum Mechanical Cross Section for Ionisation of Helium by Electron Impact. W. W. Wetzel. *Phys. Rev.* 44. *pp.* 25–30, *July* 1, 1933.—By using Born's collision theory without exchange the effective ionisation cross section is calculated for helium when the resulting ion is left in the normal state. A plane wave is used as a mathematically manageable substitute for the hyperbolic functions previously employed to represent the ejected electron. A comparison is made of the calculated cross section with the experimental values obtained by P. T. Smith. The maximum of the calculated curve falls at approximately three times the ionisation potential. The calculation predicts that the maximum probability of ionisation occurs when the energy transfer is about 3·5 volts greater than the ionisation potential. AUTHOR.

3735. Detection of Impurities in Canal Rays by Electron Diffraction. H. Raether. *Phys. Zeits.* 34. *pp.* 492–493, *June* 15, 1933. —The black deposit found on an object placed in the path of H canal rays is investigated by electron diffraction and found to consist of carbon. The method is sensitive enough to detect the presence of very small quantities of CO_2 in the discharge tube. F. C. C.

3736. Radiation from Canal Ray Impact. F. L. Verwiebe. *Phys. Rev.* 44. *pp.* 15–19, *July* 1, 1933.—Hydrogen canal rays accelerated in fields up to 40 kV were allowed to impinge on a metal target and the beam of particles and radiation emitted from the target were investigated. Pinhole images of the focal spot were obtained on Schumann plates and plates coated with molybdenum trioxide. The presence of atomic hydrogen was shown by a characteristic light blue colour produced on molybdenum trioxide plates. By means of a deflecting magnetic field it was found that the beam from the target consisted mainly of neutral particles (or of radiation) but contained a smaller number of protons whose velocity was practically equal to that of the protons incident on the target. The neutral particles by virtue of their ability to affect a photographic plate could suggest the presence of electromagnetic radiation. A grating was used to detect such radiation. Radiation of wave-length 1216 Å was excited in the residual gas by the canal ray beam when the pressure was as low as 10^{-4} mm of Hg. Any characteristic radiation from the target excited by canal ray impact is too small to be measured. AUTHOR.

3737. Theory of Gas-Focussing of Electron Streams. O. Scherzer. *Zeits. f. Physik,* 82. 11–12. *pp.* 697–708, *May* 30, 1933.—A mathematical investigation, using certain simplifying assumptions, of the equilibrium condition of gas-focussed electron streams. In the special case of the focussed stream (*Knotenstrahl*) the electron and ion density over the whole cross-section is constant. The limiting curve of this type of stream differs only slightly from a sine curve. From the relation between current, ionisation probability and the dimensions of the stream it is shown that the distance between foci (*Knoten*) is always greater than $\frac{\pi}{\epsilon p}\sqrt{\frac{m-}{m+}}$ where ϵp is the ionisator-probability, and $m-/m+$ is the ratio of the electron mass to the mass of the ion. A. B. W.

3738. Influence of Nature of Gas on Focussing of Electron Streams. E. F. Richter. *Phys. Zeits.* 34. *pp.* 457–458, *June* 1, 1933.—The paper describes an experimental investigation of the influence of the nature of the gas on the focussing of the stream of kathode rays in an A.E.G. kathode-ray tube, using an indirectly heated oxide-coated kathode. Maintaining the accelerating voltage and heating current constant, the pressure of the gas is varied, and observations made of the pressure range over which good focussing is possible. The following results are tabulated :

Gas.	H_2	He	Ne	N_2	A	Kr	X
Pressure in 10^{-3} mm Hg	8 to 10	19 to 20	4·6 to 5·4	0·8 to 1·6	0·9 to 1·1	0·8 to 0·9	0·25 to 0·3

Plotting these experimental values of pressure as a function of ionisation-probability (efficiency of ionisation as determined by Tate and Smith [see Abstract 2090 (1932)] the author reaches the following conclusion : " The smaller the ionisation-probability of the gas, the higher must be the gas pressure for effective focussing of the electron stream." A. B. W.

3739. Theory of the Electron Microscope. W. Glaser. *Zeits. f. Physik*, 83. 1–2. *pp*. 104–122, *June* 6, 1933.—The geometrical optics of electron rays in an electromagnetic field with axial symmetry set out in a previous paper [see Abstract 2001 (1933)] is developed further. C. B. A.

3740. Formation of Pictures of Thin Sheets Traversed by Rays in the Electron Microscope. B. v. Borries and E. Ruska. *Zeits. f. Physik*, 83. 3–4. *pp*. 187–193, *June* 14, 1933.—The experimental conditions for sharp electron pictures are summarised. With magnetic lenses of small field geometry error there can be self delineated in the electron microscope through metal leaves sufficiently sharp pictures directly overlying networks and structure pictures of the leaves. By shutting out the rays not sufficiently near the axis, uncorrected coils also afford good pictures. The phenomena exhibited represent the known conceptions on absorption, loss of velocity and diffusion of the kathode rays on passage through matter. [See Abstract 335 (1933.] J. J. S.

3741. Electron Optics. V. K. Zworykin. *Frank. Inst., J*. 215. *pp*. 535–555, *May*, 1933. *Paper read before the Optical Soc. of America, Feb.*, 1933.—For many experiments in physics and in some engineering applications, it is necessary to produce electron bundles, or, as they are often called, " electron beams," of considerable intensities. Various methods have been used for directing a cloud of electrons evaporated from an emitting surface into a beam and then concentrating this beam to a desired degree. The concentration of electron beams in high vacuum depends entirely upon fields of force, either electric or magnetic, while in low vacuum or in rarefied rare gas it depends also upon the action of the field of ionised gas molecules. In high vacuum the fields of force act upon the electron beam in a manner similar to the action of lenses upon a beam of light. An improperly shaped field produces effects similar to spherical aberration in poorly corrected lenses ; non-uniform velocity of electrons in the beam results in effects similar to chromatic aberration of light. This optical analogy is not perfect. In the case of the electron beam the velocity varies continuously throughout most of the path and indices of refraction employed usually are greater than in the optical case. Moreover, space charge in beams of high intensity limits the concentration attainable ; consequently, even theoretically, an electron beam can never be brought up to a mathematical point as in the case of light optics. Many secondary effects are present which complicate the problem still further. In focussing electron beams, both electrostatic and electromagnetic methods have been used extensively. The electrostatic method, however, seems to be preferable, especially when the beam is to be deflected. Precautions should be taken not to destroy the focussing of the beam during deflection. AUTHOR.

3742. Theory of Electron Optics. J. Picht. *Zeits. f. techn. Physik*, 14. 6. *pp.* 239–241, 1933.—Formulæ are derived for the focal length and the position of the principal point of an "electric lens." The second approximation formula given by Scherzer [see Abstract 1592 (1933)] for the focal length is identical with the author's earlier formula [see Abstract 1196 (1933)]. The results now given are still closer approximations. A. W.

3743. Heterogeneous Chemical Reactions in the Silent Electric Discharge. Part V. S. Miyamoto. *Hiroshima Journ. Sci.* 3. *pp.* 209–226, *March*, 1933. *In English.*—The reduction by hydrogen of twelve salts in the silent electric discharge has been studied. Lithium, sodium, and cobalt sulphates yield the corresponding sulphides ; cadmium chloride yields cadmium ; alkali and alkaline earth nitrates yield nitrite and ammonia, whilst from silver nitrate nitrite, oxide, metal, ammonia, and nitrogen peroxide are produced. Sodium nitrite yields sodium hydroxide, nitrogen peroxide, and ammonia. H. F. G.

3744. Ignition of Explosives by Ion and Electron Impacts. H. Kallmann and W. Schränkler. *Naturwiss.* 21. *pp.* 379–382, *May* 26, 1933.—Describes experiments made on trinitrotoluene, mercury fulminate, nitrocellulose and some other explosives in vacuum, with the help of a current of electrons or ions of different kinds in order to ascertain what currents and pressures are necessary to produce explosion. A sketch of the vacuum tube with electrodes, etc., is given. It is found that electrons will not cause explosion, but only ions, the heavier ions being more effective than the lighter ones. Measurements of pressure and current are given for the different explosives. The authors conclude that for explosion it is necessary to excite the nucleus oscillations of the explosive. T. B.

3745. Decomposition of Sodium Azide by Controlled Electron Bombardment and by Ultra-Violet Light. R. H. Müller and G. C. Brous. *J. Chem. Phys.* 1. *pp.* 482–491, *July*, 1933.—The decomposition of crystalline sodium azide has been brought about by bombardment with 11·65 ± 0·2 volt electrons. The material to be decomposed was placed on the plate of a specially designed three electrode valve and the decomposition rate studied as a function of the voltage of the bombarding electrons. All decomposition rates were determined by the pressure change as measured on an ionisation manometer, sodium azide decomposing into pure sodium and nitrogen. Periodic discontinuities in pressure were observed which are associated with the ionisation manometer and the crystalline sodium azide. Solid sodium azide has been found to be decomposed photochemically by wave-lengths below approximately 405 $m\mu$. The rate of decomposition was directly proportional to the light intensity. There is no apparent relation between energies necessary for the electronic and photochemical decomposition. AUTHOR.

3746. Recombination of Atomic Hydrogen into Molecules in the Tungsten Arc. F. J. Havlicek. *Helv. Phys. Acta*, 6. 3. *pp.* 165–197, 1933. *In German.*—Atomic hydrogen is used in welding processes, where its conversion into molecular hydrogen greatly increases the temperature of the points to be welded. This process of reconstruction is investigated experimentally in the tungsten arc at atmospheric pressure. The reconstruction exhibits a monomolecular character. The higher the temperature the greater the velocity of reaction of the recombination; at room-temperatures the half-value time is about ⅛ sec. H. L. B.

3747. Behaviour of Probes in Neon Discharge. E. Reichrudel and G. Spiwak. *Ann. d. Physik,* 17. 1. *pp.* 65–82, *May,* 1933.—In order to determine the causes of the special nature of the probe characteristics in Ne discharges, an investigation was made of the effect of illumination with an external Ne light source. This caused a corresponding variation of the probe current. The probe could be moved to different positions in the discharge tube. The effect of illumination was determined, as a function of the potential of the probe relative to the discharge and also for the two cases where the probe was located (*a*) within and (*b*) outside the positive column. It was found that external illumination can under certain conditions increase the probe current and in others reduce it. By variation of the concentration of the metastable atoms it was found possible to obtain a normal probe characteristic in the Ne discharge, quite similar to that found with Hg vapour. Experiments were undertaken to find out whether the metastable atoms or the immediate photoelectric effect of the resonance radiation cause a secondary emission from the probe. The results obtained show that the principal part of the variation of the probe current is due to the effect of the metastable atoms. A. W.

3748. Mass Spectrometer with Direction and Velocity Focussing. H. Bondy and K. Popper. *Ann. d. Physik,* 17. 4. *pp.* 425–444, *June* 19, 1933.—On the basis of theory given previously by Bartky and Dempster [see Abstract 3631 (1929)], a new mass spectrometer was constructed, which by combination of a radial electric field and a transverse magnetic field, allowed of direction and velocity focussing. The entire apparatus, including the anode and collector, was situated between the pole-pieces of the electromagnet. Using a hard glass anode, curves were obtained for Na^{23} and K^{39} and the resolving power of the instrument was estimated. An improved apparatus is under construction. F. C. C.

3749. Simple Portable Wilson Chamber. K. Philipp and F. Dörffel. *Phys. Zeits.* 34. *pp.* 491–492, *June* 15, 1933.—A simple, portable, hand-operated Wilson chamber for the demonstration of the tracks of α-, β- and H-particles, has been designed. The chamber is 12 cm. in diameter and the whole apparatus weighs 30 kg. F. C. C.

3750. Technique and Design of Wilson Cloud-Chambers. O. Dahl, L. R. Hafstad and M. A. Tuve. *Rev. Sci. Instruments,* 4. *pp.* 373–378, *July,* 1933.—The alterations in design of a Wilson-Blackett automatic cloud-chamber apparatus, found necessary or convenient in adapting it to photographing tracks of high-speed ions from a high-voltage tube, are briefly described. An experimental cloud-chamber, which can be oriented in any position, constructed from a six-inch diameter metallic sylphon-bellows, free from leaks and with several other advantages, is shown. A convenient type of mercury spark-lamp which makes possible the use of fine-grained positive-emulsion films is described. Designs are given for a larger sylphon-type chamber based on the satisfactory experience with the smaller chamber. AUTHORS.

3751. Portable Double Geiger Counter. R. D. Bennett, J. C. Stearns and W. P. Overbeck. *Rev. Sci. Instruments,* 4. *pp.* 387–390, *July,* 1933.—A portable double Geiger coincidence counter is devised using screen-grid valves with non-linear amplification in the first stage and a grid-glow tube in the second stage. The total weight of the apparatus and batteries is about 100 lb. F. C. C.

3752. H.T. Constant D.C. Generator. N. Mortara. *Accad. Lincei, Atti,* 17. *pp.* 730–734, *May* 7, 1933.—Three transformers have their primaries connected to a 3-phase supply and their secondaries connected in series. Three corresponding ends of the secondaries are jointly connected to two plates of two condensers C_1 and C_2: the other ends are each connected to (1) the plates of three separate valves V_4, V_5 and V_6, (2) the filaments of three further separate valves V_1, V_2 and V_3. The filaments of V_4, V_5 and V_6 are connected to the other plate of C_2 and the plates of V_1, V_2 and V_3 are connected to the other plate of C_1. Leads from these two condenser plates form the new d.c. supply at high tension. The d.c. was found to be moderately free from ripple under test with kathode ray oscillographs. F. C. C.

3753. Impulse Generator Operating at Three Million Volts. d'Arsonval. *Comptes Rendus,* 196. *pp.* 1934–1937, *June* 26, 1933.—An impulse generator having the following properties is described :—

Number of condensers 100 ; capacity per condenser 0.5 mf. ; maximum tension per condenser 30,000 volts ; total energy of discharge 22,500 joules ; maximum instantaneous current 3000 A ; maximum instantaneous power 9,000,000 kW.

F. C. C.

See also Abstracts 3281, 3467, 3476, 3539, 3540, 3551, 3552, 3652, 3799, 3800.

CONDUCTION IN SOLIDS AND LIQUIDS.

3754. Electrostatic H.T. Voltmeter. G. S. Field. *Canad. J. of Research,* 8. *pp.* 575–576, *June,* 1933.—An electrostatic voltmeter which is of fairly simple construction is described. It has a scale which is more nearly linear than is usually found with such instruments, and which can be applied to several different voltage ranges. AUTHOR.

3755. Measurement of Peak Values of Alternating Currents and Voltages by Means of a Thyratron. E. Hughes. *Journ. Sci. Instruments,* 10. *pp.* 180–182, *June,* 1933.—This paper deals with the use of a thyratron for measuring the maximum value of an alternating voltage such as the potential drop in a low-resistance shunt carrying an alternating current. By this method the maximum value of the potential difference can be determined within 0·02 V. Reference is made to the various precautions necessary to ensure reliable and consistent readings. AUTHOR.

3756. Condenser Resistance Measurement by use of a Variable Mutual Inductance. W. Jackson. *Manchester Phil. Soc., Mem.* 76. *pp.* 69–83, 1931–1932.—A method is described for measuring the resistance of a condenser in terms of a variable mutual inductance. The errors which result from the small self capacities of the mutual inductance are discussed, and details are given for the construction of a mutual inductance suitable for testing a variable air condenser of maximum capacity 2000 micro-microfarads in the region of 1000 m. wave-length. Results are given for the resistance of this condenser at wave-lengths ranging from 800 to 1350 m. The values are checked by independent determinations of the resistance of the primary coil of the mutual, and of the combined resistance of this coil and the condenser. R. W. P.

3757. Two Simple Methods of Absolute Measurement of Resistance in Terms of Inductance and Frequency. H. R. Nettleton and E. G. Balls. *Phys. Soc., Proc.* 45. *pp.* 545–554, *July* 1, 1933.—In the first method a sinusoidal a.c. of some 15mA derived from a valve oscillator and of frequency equal to that of a König tuning-fork is allowed to induce an equal current in a secondary circuit. The equality of amplitude of the primary and secondary currents is judged with the aid of a Westinghouse instrument rectifier. The resistance of the secondary circuit is given by the expression $S=2\pi n\sqrt{(M^2-N^2)}$, where n is the frequency, N the self-inductance of the secondary and M the mutual inductance between the primary and secondary. With standard forks of frequencies 256, 320, 384 and 512, resistances have been measured ranging from 16Ω to 67Ω. In the second method equal primary and secondary currents of known frequency are also produced and are further adjusted to be in quadrature. A simple arrangement is thereby derived which enables Campbell's two-phase a.c. method of measuring resistance to be carried out in the laboratory. In both methods a visibly beating circuit is employed which enables the frequency of the current used to be tuned easily, with precision, to that of a valve-maintained fork. This beating circuit is also of value in checking the relative accuracy of forks whose frequencies are very approximately in simple ratio to one another.

AUTHORS.

3758. New Detector. J. Cayrel. *Comptes Rendus,* 196. *pp.* 1216–1218, *April* 24, 1933.—In 1921 (Miss) Collet found that "insensitive" galena provided a rectification in the reverse sense, and subsequently the author found that this rectification was enhanced by the employment of noble metals for contacts. If a fresh surface of galena is broken and plunged as anode into a solution of sulphuretted hydrogen, it becomes coated with a brownish dust consisting of small octahedral crystals of sulphur. A point of copper in contact with these crystals is converted into sulphide, and forms with the galena an excellent and stable detector.

E. E. F. d'A.

3759. Potential Discontinuities at the Contact of a Semi-Conductor and a Metal. G. Déchêne. *Comptes Rendus,* 196. *pp.* 1577–1579, *May* 22, 1933.—A brief account is given of experimental work upon the influence of physical conditions upon contact resistances. The production of discontinuities of potential at a semi-conductor-metal interface is attributed to the difficulty of transfer of electrons from one medium to another. Near each electrode the electric force produces an excess charge of one sign. The substance thus possesses a volume density ρ penetrating to a depth d. If E_0 is the electric field at the contact then the discontinuity of potential is $KE_0^2/8\Pi\rho$, and the capacity of contact per sq. cm. is $C=K/2\Pi d$, where K is the dielectric constant of the substance. The effect of pressure, raising the temperature, and illuminating the surface, should be to facilitate the exchange of charge between the semi-conductor and the metallic electrode and so to reduce E_0 and consequently the discontinuity of potential (for a given current density). This was verified by experiment, and from a measurement of the capacity C a value for *d* was obtained of the order of $10^{-4}-10^{-2}$ cm. J. E. R. C.

3760. Theory of Electronic Semi-Conductors and their Possible Properties. R. H. Fowler. *Roy. Soc., Proc.* 140. *pp.* 505–522, *June* 1, 1933. *Phys. Zeits. d. Sowjetunion,* 3. 5. *pp.* 507–528, 1933. *In English.*—Wilson's theory of semi-conductors [see Abstract 1328 (1932)] is presented in a simple form and applied to three different models of semi-conductors. These models represent (1) pure substances of very small conductivity, (2) substances with impurities supplying excitable electrons, (3) substances with impurities absorbing excited electrons. The equilibrium state, thermionic and photoelectric work functions, contact potential, conductivity, Hall coefficients, and thermoelectric power are worked out for all these models, using where necessary as a standard of comparison, a model representing an ideal metal. The signs of the Hall coefficient and the thermoelectric power are specially examined and the possible appearance of abnormal signs in either or both of these effects accounted for. AUTHOR.

3761. Electronic Conductivity of the Copper Oxides. Part II. M. le Blanc, H. Sachse and H. Schöpel. *Ann. d. Physik,* 17. 3. *pp.* 334–344, *June,* 1933.—The specific conductivity of Cu_2O depends to a large extent on its degree of purity. Small amounts of oxygen raise it strongly. The specific conductivity at 20°C for compact pure Cu_2O amounted to $3\cdot6$ and $6\cdot6\times10^{-9}$ ohm ; the values of the same Cu_2O preparation but in a finely powdered condition compressed to a pastille were $5\cdot1\times10^{-9}$, $7\cdot8\times10^{-9}$, $1\cdot4\times10^{-8}$ ohm, with densities of packing of 72·5, 83·2, and 85·2 % respectively. Compact CuO was not obtained. CuO preparations were produced from powdered Cu_2O and respective conductivities of 3·6 and 2×10^{-6} with packing densities of 70·4 and 67·2 % were found. Neither does Cu_2O behave as an insulator nor CuO as a metallic conductor as is often assumed. Both are half conductors with positive temperature coefficients of conductivity. [See Abstract 1701 (1932).] J. J. S.

3762. Diffusion and Electrolytic Conduction in Crystals (Ionic Semiconductors). W. Jost. *J. Chem. Phys.* 1. *pp.* 466–475, *July,* 1933.—In the present paper a mechanism of diffusion and electrolytic conduction in solids is discussed, which is based on a formal treatment given by Frenkel. It is assumed that in a crystal in thermal equilibrium some of the atoms or ions are removed from their normal positions in the lattice to irregular ones in the interlattice space. Then diffusion and electrolytic conduction is possible by two processes ; first by migration of the ions in the interlattice space, second by migration of the vacant places. The number of ions in the interlattice space can be calculated. If one considers the influence of polarisation the result agrees in the order of magnitude with the observed data. It is also shown that the activation energy connected with the processes of movement is of the correct order of magnitude. Thus a satisfactory explanation of the exponential factor occurring in the empirical conductivity (or diffusion) formula is obtained. The constant factor multiplying the exponential can be explained at once for one group of cases ; for the other group, where the constants apparently are too high, a tentative explanation is proposed. AUTHOR.

3763. Mechanism of Supraconductivity. C. Benedicks. *Ann. d. Physik,* 17. 2. *pp.* 169–184, *May,* 1933.—Discusses the theory of supraconductivity from the viewpoint of the so-called " phoretic " theory, in which the valency electrons are supposed to be free for part of the time, and to pass from atom to atom. J. H. A.

3764. Possible Explanation of Supraconductivity. J. Frenkel. *Phys. Rev.* 43. *pp.* 907–912, *June* 1, 1933.—An attempt is made to explain the phenomenon of supraconductivity by taking into account the electromagnetic (inductive) forces which the electrons exert on each other when they move in an organised way. These forces stabilise the motion against the perturbations due to the thermal agitation of the crystal lattice. They can also entail a decrease of energy which may explain the thermodynamic stability of the supraconducting state at low temperatures. The theory is not carried to the point of numerical calculation. AUTHOR.

3765. Electrical Properties of Thin Films of Platinum Obtained by Kathode Bombardment. A. Féry. *Ann. de Physique,* 19. *pp.* 305–507, *May–June,* 1933. *J. de Physique et le Radium,* 4. *pp.* 301–315, *June,* 1933.—Films of Pt black are prepared in a discharge tube containing air, water vapour being excluded. The experimental law, valid between thicknesses of 10 $m\mu$ and 1320 $m\mu$, connecting the thickness e of the films, measured by their opacity, with the resistivity ρ, may be resolved into two curves given by the equations $2 \log \rho/\rho_0 = 11 \cdot 48 - 0 \cdot 0315\, e$ and $2 \log \rho/\rho_0 = 3 \cdot 245$, where $\rho_0 = 10^{-5}$ ohm-cm., the average resistance of ordinary Pt. The curves join between 237 and 285 $m\mu$. At thicknesses greater than 285 $m\mu$ the metal which is still black and is adsorbent and catalytic may be considered as massive, but its resistivity is 42 times greater than that of ordinary Pt. Owing to the feebleness of the discharge the temperature is maintained sensibly constant, but if the film is heated the resistance changes in a reversible manner until a certain threshold temperature is reached, after which the change is irreversible. On raising the temperature further the same phenomenon is repeated and a series of reproducible transformation points is obtained at 53°, 83°, 97°, 114°, 140°, 241° and 340°. Only at 340° has the resistance decreased to a value comparable with that of ordinary Pt. For the first 3 temperatures feeble evolutions of gas occur. Films less than 3·4 $m\mu$ thick have an immeasurably great resistance; this drops abruptly as the thickness is increased and joins the exponential curve at about 7 $m\mu$. After transformation of the Pt black to white Pt, the critical thickness diminishes to about 50 $m\mu$, but for very small thicknesses the curve joins the curve for Pt black. F. C. C.

3766. Electrical Resistance of Hydrogen-Charged Palladium Wires. H. Hagen and A. Sieverts. *Zeits. f. phys. Chem.* 165. *Abt.A.* 1–2. *pp.* 1–11, *June,* 1933.—Measurements were made of the electrical resistance of palladium wires in a hydrogen atmosphere at temperatures up to 470° C. and with hydrogen pressures up to 140 kg./cm². Thus the measurements previously made were confirmed and extended [see Abstract 2559 (1933)]. As measure of the raising of resistance the ratio Q of the resistances of the charged and uncharged wires at the same temperature was taken. The highest values of Q (Q max.) were approximately 1·56 for all temperatures of investigation up to 362° C. The corresponding pressures rise with increasing temperature. At temperatures over 362° in the pressure range of the investigation Q max. was not attained. J. J. S.

3767. Differences between the Conductivity Coefficients of Strong Electrolytes in the Same Solvents. M. Hlasko. *Acad. Polonaise Sci. et Lettres, Bull.* 10A. *pp.* 336–346, *Dec.,* 1932.—The solvents employed were water, acetonitrile, pyridine, aniline, and the alcohols: methyl, ethyl, propyl and butyl. The dielectric constant of the various strong electrolytes varied between 80 and 7. The differences between the conductivity coefficients were: $f_{\mu}^{\mathrm{HI}} - f_{\mu}^{\mathrm{HBr}} < f_{\mu}^{\mathrm{HBr}} - f_{\mu}^{\mathrm{HCl}}$, $f_{\mu}^{\mathrm{KOH}} - f_{\mu}^{\mathrm{NaOH}} < f_{\mu}^{\mathrm{NaOH}} - f_{\mu}^{\mathrm{LiOH}}$. In the cases of salts with the same kation ($\mathrm{Me}^+ = \mathrm{Li}^+, \mathrm{Na}^+, \mathrm{K}^+, \mathrm{Rb}^+, \mathrm{Cs}^+, \mathrm{NH_4}^+$) or anion ($\mathrm{X} = \mathrm{Cl}^-, \mathrm{I}^- \mathrm{NO}^-_3$): $f_{\mu}^{\mathrm{MeF}} < f_{\mu}^{\mathrm{MeCl}} < f_{\mu}^{\mathrm{MeBr}} < f_{\mu}^{\mathrm{MeI}}, f_{\mu}^{\mathrm{LiX}} < f_{\mu}^{\mathrm{NaX}} < f_{\mu}^{\mathrm{KX}} < f_{\mu}^{\mathrm{RbX}} < f_{\mu}^{\mathrm{CsX}}$ and $f_{\mu}^{\mathrm{MeI}} - f_{\mu}^{\mathrm{Me\,Br}} < f_{\mu}^{\mathrm{Me\,Br}} - f_{\mu}^{\mathrm{Me\,Cl}}, f_{\mu}^{\mathrm{KX}} - f_{\mu}^{\mathrm{NaX}} < f_{\mu}^{\mathrm{NaX}} - f_{\mu}^{\mathrm{LiX}}$. These differences increase when the dielectric constant of the solvent diminishes and attain values 500 % > the coefficients themselves, which may be due to the presence of undissociated molecules. H. H. Ho.

3768. Electrical Conductivity of Aqueous Solutions of the Alkali Metal Hydroxides. J. Goworecka and M. Hlasko. *Acad. Polonaise Sci. et Lettres, Bull.* 1–3A. *pp.* 77–86, *Jan.–March,* 1933. *In French.*—Solutions were made up in barium hydroxide solution to eliminate the effects of CO_2. The observed conductivities were compared with those calculated from the Onsager equation. The mobility of the OH ion is 200·2 at 25° C. A. S. C. L.

3769. Solubility of Lime in Water and the Specific Conductivities of its Saturated Solutions. A. D. Grieve, G. W. Gurd and O. Maass. *Canad. J. of Research,* 8. *pp.* 577–582, *June,* 1933.—The specific conductivities of saturated solutions of calcium hydroxide have been measured from 0° to 130° C. Special precautions were taken to eliminate errors due to impurities. The degree of dissociation and so-called dissociation constants have been calculated for these solutions from 0° to 100° C. These data have been used to calculate a new set of solubility data for calcium hydroxide at temperatures from 0° to 25° C. Solubilities of calcium hydroxide have been measured over this temperature interval by an indirect method, and the results are in fair agreement with the calculated values. AUTHORS.

3770. Conductivity and Potential Measurements with Salts of the Higher Alkyl Sulphonic Acids. A. Lottermoser and F. Püschel. *Kolloid Zeits.* 63. *pp.* 175–192, *May,* 1933.—Various salts (sodium, potassium, silver, barium, calcium, magnesium, zinc, iron, copper) of saturated alkyl sulphonic acids containing 12, 14, 16 and 18 carbon atoms have been prepared and the conductivities and kation concentrations of aqueous solutions of several concentrations have been measured at a number of temperatures between 25 and 70° C. The equivalent conductivity-concentration curves pass through a maximum at high concentrations ($0{\cdot}25 - 1{\cdot}0\ M$) and a minimum at lower concentrations ($0{\cdot}1$–$0{\cdot}01\ M$); with increase of molecular weight the minimum shifts to lower concentrations. The free acids exhibit similar behaviour. The activity of the silver ions in solutions of the silver salts varies with concentration in almost the same way as does the equivalent conductivity. The solutions resemble soap solutions in that there exists equilibrium between single ions, single molecules, aggregations of molecules, and aggregations of ions, which is governed by the molecular weight, temperature, and the concentration of the solution. Aggregation takes place more readily when the kation is divalent. The minimum surface tension of the solutions occurs at the concentration indicated by the conductivity and potential measurements as being that at which marked aggregation of the neutral molecules commences. H. F. G.

3771. Conductivity of Mixtures of Acetic Acid with Various Amines. N. A. Puschin and P. S. Tutundžic. *Zeits. f. Elektrochem.* 39. *pp.* 305–308, May, 1933.—The conductivity and temperature coefficient of the conductivity of mixtures of acetic acid with pyridine, α-picoline, 2–4-lutidine, quinoline, and ethylbenzylaniline has been determined as a function of the composition. In all cases the conductivity passes through a maximum at 85–95 % acetic acid, and is greatest for the pyridine mixtures and least for ethylbenzylaniline mixtures. The viscosity also is a maximum at the concentration at which each mixture exhibits maximum conductivity. The results do not, however, lead to any conclusion regarding the formation of compounds. H. F. G.

3772. Conductivity Measurements in Aniline. P. Walden and L. F. Audrieth. *Zeits. f. phys. Chem.* 165. *Abt.A.* 1–2. *pp.* 11–25, *June,* 1933.—The conductivities of tetraethylammonium picrate and iodide, tetraisoamylammonium picrate and perchlorate, di-isoamylammonium picrate and chloride, and aniline, piperidonium and silver picrates in aniline ($\chi_{250} = 2 \cdot 5 \times 10^{-9}$) have been measured at 25° in dilutions up to about 250,000 litres. The square root law proves valid and the limiting conductivity $\Lambda\infty$ may be determined graphically or by calculation. Aniline is characterised as a strongly differentiating solvent. Although aniline picrate has an ion allied to the solvent, it shows very slight ionic mobility and behaves as a quite weak salt. The so-called Grotthus conductivity cannot be accepted for this solvent. The solvated hydrogen ion, $H^{\cdot}\cdot C_6H_5NH_2$ has, therefore, slight mobility. Strong binary salts in aniline (with the low dielectric constant, 7·2) obey the law of mass action and thus behave as incompletely dissociated electrolytes. For the salts of tetra-alkylammonium ions deviations from Walden's law occur, and abnormal behaviour of the tetra-alkylammonium ion is presumed. On the assumption that the product $l\eta$ for the picrate ion has the constant value 0·267, the ionic mobilities in aniline are calculated. T. H. P.

3773. Conductivity Measurements in Acetophenone. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 165. *Abt.A.* 1–2. *pp.* 26–31, *June,* 1933.—The conductivities of tetraethylammonium picrate and chloride, and diethylammonium picrate and chloride in acetophenone (χ_{25} about 1×10^{-8}) have been measured at 25° in dilutions up to about 100,000 litres. With dilutions exceeding 3000 litres, Kohlrausch's square root law holds for the strong and medium-strong salts. Tetraethylammonium picrate in acetophenone shows divergences from Walden's rule. The ionic mobilities are calculated. T. H. P.

3774. Conductivity Measurements in Cyclohexanone. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 165. *Abt.A.* 1–2. *pp.* 32–38, *June,* 1933.—The conductivities of solutions of tetraethylammonium picrate, perchlorate, and chloride, and of diethylammonium picrate and chloride in cyclohexanone ($\chi_{25} = 6 \times 10^{-8}$) at 25° and at dilutions up to 50,000 litres have been measured. The results conform with Kohlrausch's square root law, and the solvent belongs to the differentiating class. With tetraethylammonium picrate, Walden's law is not obeyed. For the Debye-Hückel-Onsager equation, deviations occur, these depending on the strength of the salt: the higher the degree of classical dissociation, the smaller is the divergence. When various ketones with similar dipole moment and dielectric constant are compared, the chemical influence of the solvent is shown in the magnitude of the Δ-values. T. H. P.

3775. Properties of Electrolytic Solutions. Part IV. Conductance Minimum and Formation of Triple Ions Due to the Action of Coulomb Forces. R. M. Fuoss and C. A. Kraus. *Am. Chem. Soc., J.* 55. *pp.* 2387–2399, *June,* 1933.—The hypothesis is made that a triple ion, formed from a neutral molecule and a simple ion by the action of electrostatic forces, will exist as a stable structure in solvents of low dielectric constant. The presence of triple ions of the above type accounts in a large measure for the appearance of minima in conductance curves. Dissociation constants for the triple ions computed theoretically agree with values obtained from conductance data. The observed shift of the minimum of conductance towards higher concentrations with increasing dielectric constant of the solvent is given theoretical basis. [For Part III see Abstract 2593 (1933). AUTHORS.

3776. Conductivity of Thin Films of Liquid Hydrocarbons. A. E. van Arkel and W. Koopman. *Physica,* 13*e*. 6. *pp*. 189–192, 1933.—Brüninghaus [see Abstract 2003 (1931)] pointed out that thin layers of mineral oils between metal electrodes behave as conductors. It seems that this behaviour is not due to the pure oils, but is caused by decomposition of the oil, whereby probably carbon particles are formed. In the case of iron electrodes separated by air, small glowing particles become visible, as soon as a current passes. AUTHORS.

3777. First Comparisons of National Electrical Resistance Standards by the International Bureau of Weights and Measures. A. Pérard and M. Romanowski. *Comptes Rendus.* 196. *pp*. 1288–1291, *May* 1, 1933.—Twelve resistance standards of 1 ohm each were compared with one another, using a Kelvin double bridge. Of these resistances two (R and R^1) were from the Physikalisch-Technische Reichsanstalt, Berlin, two (N and N^1) from the National Physical Laboratory, Teddington, two (C and C^1) from the Laboratoire Central d'Électricité, Paris, two (E and E^1) from the Electrotechnical Laboratory, Tokyo, and four (I_1, I^1_1, I_2, I^1_2) from the Bureau International des Poids et Mesures. All the resistances were of similar type; they had been transported by hand to the Bureau International and after their arrival maintained in one room at a temperature of 20° C. The measurements carried out, together with previous knowledge of the thermal coefficients of certain standards, gave (i) the absolute thermal coefficients of all the standards, which ranged from $-0\cdot8$ to $+27\cdot6$ microhms per degree; (ii) the coefficients of absolute variation with time, which ranged between $-0\cdot022$ and $+0\cdot031$ microhm per day for the national ohms and between $-0\cdot271$ and $-0\cdot007$ microhm per day for the standards of the Bureau International, of recent manufacture; (iii) the magnitude of the mean unit Ωm of the four laboratories. The value of each standard, in terms of the mean unit on Dec. 30, 1932, is given in the following table:

$R = 1\cdot0000195\ \Omega m$, $R^1 = 1\cdot0000943\ \Omega m$, $E = 1\cdot0000717\ \Omega m$, $E^1 = 1\cdot0001713\ \Omega m$.
$N = 0\cdot9999654\ \Omega m$, $N^1 = 0\cdot9999141\ \Omega m$, $C = 1\cdot0000250\ \Omega m$, $C^1 = 1\cdot0000465\ \Omega m$.
$I_1 = 1\cdot0000163\ \Omega m$, $I^1_1 = 1\cdot0000128\ \Omega m$, $I_2 = 1\cdot0000533\ \Omega m$, $I^1_2 = 1\cdot0000480\ \Omega m$.

The unit proper to each country was found to be :

Germany 0·9999875 Ωm, France 1·0000623 Ωm.
England 0·9999763 Ωm, Japan 0·9999739 Ωm.

A. W.

See also Abstracts 3790, 3791, 3806.

DIELECTRICS AND CAPACITANCE.

3778. Dielectric Polarisation in Solid Bodies. J. Errera. *Phys. Zeits. d. Sowjetunion,* 3. 5. *pp.* 443–468, 1933. *In German.*—This paper is essentially a review of work carried out between 1924–32 and deals with (1) solid bodies in which the total polarisation is ascribed to electronic and ionic oscillations, and (2) solid bodies in which the total polarisation arises from electronic polarisation and then especially from orientation polarisation (permanent dipole). The behaviour of the dielectric constant on solidification exhibits the following regularities : (*a*) Liquids whose molecules are not polar show an increase of the dielectric constant with change into the solid state corresponding to the similar density increase. (*b*) Liquids with polar molecules at frequencies of $10^7 \sim$, where in the liquid state the dipoles still oscillate, afford a strong decrease of the dielectric constant on solidification. (*c*) In certain cases, colloidal separations of very high electric moment appear to form during solidification.

H. H. Ho.

3779. Space-Charges in Ice. G. Oplatka. *Helv. Phys. Acta,* 6. 3. *pp.* 198–209, 1933. *In German.*—The anomalous dispersion of the dielectric constant of ice is well represented by a formula of the type $\epsilon = a + b/(1 + cw^2)$, which involves three constants. The validity of this relationship sheds no light, however, on the mechanism of the dispersion. It may be produced by a stratified structure of the medium, by directed polarisation or by space-charges ; in each case a formula of the above type is characteristic. By measuring the variation of potential in ice rods by means of probes it is possible to test whether space-charges are present. No such charges are found in perfectly pure ice, but in the case of ice which has not been completely de-gassed during freezing strong space-charges are detected. Variations of current with time are also studied in both kinds of ice. H. L. B.

3780. Dipole Rotation and the Transitions in the Crystalline Hydrogen Halides. C. P. Smyth and C. S. Hitchcock. *Am. Chem. Soc., J.* 55. *pp.* 1830–1840, *May,* 1933.—Using frequencies of from 300 to 60,000 cycles an investigation of the dielectric constants of HCl, HBr and HI has been carried out at temperatures varying from the freezing point to − 189° C. Special attention has been paid to transition regions and ascertained transitions agree with existing data from heat-capacity measurements. For some distance below the melting points the molecules in the crystalline solids orient in the externally applied field to almost the same extent as in the liquid. Usually between transitions the polarisation varies inversely as the absolute temperature. Change in molecular rotation at the transitions may result in an increase or decrease in the dipole orientation in an externally applied field. W. R. A.

3781. Deflection of Molecular Rays in an Electric Field : Electric Moment of Hydrogen Chloride. I. Estermann and R. G. J. Fraser. *J. Chem. Phys.* 1. *pp.* 390–399, *June,* 1933.—A comparison of the method for determining electric moments of molecules by deflection of molecular beams by inhomogeneous electric fields with the dielectric constant method shows that the molecular beam method has certain advantages. This method determines the electric moment of gases directly and is able to detect the effect of higher rotational states of non-gyroscopic molecules. Moreover, a deviation of the axis of the dipole moment from that of the axis of rotation by other than 90° should be detected. The additional energy due to an electric field is proportional to the square of the field intensity and is a function of the quantum numbers m and j, if the electric moment is perpendicular to the axis of rotation. Otherwise there will be a linear dependence on the intensity of the electric field. An experimental method of the Rabi type for studying the HCl molecule is described. The patterns produced by the undeflected and deflected molecules are given and from these patterns the electric moment of the HCl molecule is found to be approximately $1 \cdot 95 \times 10^{-18}$ e.s.u. AUTHORS.

3782. Electric Moments of NO_2 and N_2O_4. C. T. Zahn. *Phys. Zeits.* 34. *pp.* 461–462, *June* 1, 1933.—The dielectric constants have been measured of equilibrium mixtures of NO_2 and N_2O_4 throughout a pressure range of one atmosphere and at temperatures from 13·5° C. to 114·5° C. The concentrations of individual constituents were interpolated from the results of Bodenstein [*Zeits. f. phys. Chem.* 100. 68. 1922] and the optical constants were derived from Cuthbertson's refraction data. From these data a mean value for the term B in the Debye equation for the polarisation of a mixture can be calculated and the values $0 \cdot 12_5$ and $0 \cdot 25$ were obtained for NO_2 and N_2O_4 respectively giving corresponding values for the electric moments of $0 \cdot 3_9$ and $0 \cdot 5_5 \times 10^{-18}$ e.s.u. W. R. A.

3783. Dielectric Constant of Liquid Iodine. A. Jagielski. *Acad. Polonaise Sci. et Lettres, Bull.* 10*A*. *pp.* 327–335, *Dec.*, 1932.—The method of resonance has been employed, and the dielectric constant-temperature curve shows that liquid iodine is one of those relatively rare liquids whose temperature coefficient is positive (*e.g.*, acetic acid and certain higher alcohols). It is clear that the polarisation of liquid iodine obeys neither the law of Clausius-Mossotti nor that of Debye, a circumstance attributed to molecular association. H. H. Ho.

3784. Dielectric Strength of Thin Ta_2O_5 Films. G. Just. *Zeits. f. Physik*, 82. 1–2. *pp.* 119–133, *April* 22, 1933.—The study of the dielectric strength of extremely thin layers of tantalum oxide, 24 to 250 mμ thick, under conditions similar to those adopted by Joffé for thin glass, shows a qualitative similarity in the curves obtained. But in reality the dielectric strength is exactly proportional to the thickness of the layer. If the Ta_2O_5 is spread on a tantalum anode, and Hg in a vacuum is the kathode, then up to a thickness of 250 mμ it has a strength of two million volts per cm. E. E. F. d'A.

3785. Resistance to Penetration of Extremely Thin Layers of Ta_2O_5 and Al_2O_3 in Dependence on the Thickness of the Layer. H. Betz. *Zeits. f. Physik*, 82. 9–10. *pp.* 644–649, *May* 25, 1933.—The tenacity in resisting penetration of extremely thin layers of Ta_2O_5 and Al_2O_3 in relation to the thickness of the sheets was measured. One layer alone or two super-imposed were used. Ta or Al served as one electrode while the second consisted of a polished rod of Cu, Al, Zn, Mg, W, or Ta. It was found that with layers of the oxides mentioned there exists between

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penetration tenacity and thickness of layer partly proportionality with insignificant null point deviation, partly a linear connection with strong null point deviation. Investigations on the influence of the material of the electrode on the penetration tension showed considerable dissimilarities with the separate metals, which, however, were due not to a dependence of the penetration tension on the electrode material, but to the varying surface condition of the particular electrodes. J. J. S.

3786. Molecular Structure of Polyhydric Alcohols Deduced from their Dispersion and Absorption for Radio-Frequencies. P. Girard and P. Abadie. *Comptes Rendus*, 196. *pp.* 1995–1997, *June* 26, 1933.—By comparing the experimental absorption and dispersion curves for radiation of $\lambda 20$–5000 cm. for glycerol (at 25° and 37°), and sorbitol (at 80°) with the corresponding curves deduced from the values of the atomic radius, a (depending on the expression $4\pi\eta a^3/3kT$ for the time of relaxation) that give curves fitting as near as possible to the experimental curves, it is concluded that in glycerol there are two kinds of dipoles—simple and associated 2 and 2 united laterally, probably all becoming simple at 50°, and in sorbitol simple molecules, and molecules associated 2 and 2, 3 and 3, and perhaps 4 and 4. Ethylene glycol and xylitol at 20° show respectively slight and strong association. It is then shown that the time of relaxation decreases proportionally to the number of elementary dipoles in the molecule of a polyhydric alcohol, which implies the probability of a cylindrical or ellipsoidal shape of their molecules, these being the more elongated the greater the number of alcohol functions in the molecule. [See Abstract 4580 (1932).] **Errata,** *ibid.*, 197. *p.* 284, *July* 17, 1933. C. A. S.

See also Abstracts 3285, 3483, 3581, 3730, 3828, 3837.

ELECTROCHEMISTRY.

3787. Weston Standard Cells with Buffered Electrolytes. R. J. Priepke and W. C. Vosburgh. *Am. Chem. Soc., J.* 55. *pp.* 1801–1809, *May*, 1933.—In order to study the effect of acidity of the electrolyte a series of cells with buffered electrolytes of varying acidities was prepared. The e.m.f.s were practically constant over six to sixteen months ; hysteresis was very small in the most acidic and least acidic groups. For a similar set of cells made with basic, instead of normal, mercurous sulphate the acidity at which the basic and normal sulphates can exist in equilibrium with the same saturated cadmium sulphate solution was roughly estimated. Cells made with a mixture of the basic and normal mercurous sulphates at the mercury electrode had high e.m.f. if the acidity was above, and normal e.m.f. if below this transition point. When the mercurous sulphate layer was very thin, 1 to 2 mm., the cells were variable if the acidity was below the transition point, but not if it was above. An explanation is proposed for the slow decrease of e.m.f. often observed in neutral cells. N. M. B.

3788. Properties of Electrolytes in the Solvent Sulphuric Acid. L. P. Hammett and A. J. Deyrup. *Am. Chem. Soc., J.* 55. *pp.* 1900–1909, *May*, 1933.—Water added to sulphuric acid depresses the freezing point of the latter to an extent proportional to the water concentration (except at very low concentrations), and the slope of the concentration—freezing point line corresponds with the behaviour of the water as a strong binary electrolyte. For solutions of potassium, sodium, and barium hydrogen sulphates the van't Hoff factor, *i*, is always nearly integral, and the apparent ionisation is therefore complete. Freezing point measurements have been made with a number of organic compounds, and the types of ionisation calculated. Interpretation of the results is simple if account is taken of the large dissociation of the solvent. The ionic activity coefficients are constant over a wide concentration range. The decrease of solubility of barium sulphate in sulphuric acid, produced by the action of water, is a common ion effect due to the fact that both solutes behave as bases and give rise to the bisulphate ion ; the solubility product of barium sulphate is constant, for a solution of initial concentration $0 \cdot 8M$, over a range of water concentrations of from 0 to $3M$. H. F. G.

3789. Extent of Dissociation of Zinc Sulphate. I. A. Cowperthwaite. *Faraday Soc., Trans.* **29.** *pp.* **593–596,** *May,* **1933.**—The activity coefficients are compared for zinc sulphate, and it is shown that, on the basis that the Debye-Hückel theory is able quantitatively to interpret the behaviour of electrolytes, zinc sulphate gives evidence of being completely dissociated. The arguments are applied also to cadmium sulphate. F. J. B.

3790. Theory of Electrolysis Phenomena in Metallic Solutions. K. Schwarz. *Zeits. f. phys. Chem.* **164.** *Abt.A.* **3–4.** *pp.* **223–230,** *April,* **1933.**—Skaupy's theory, which attempts to explain electrolytic transference in metallic solutions in terms of electron friction, is shown not to be in accordance with the results of experiment. Entire disregard of electron friction leads to the view that the movement results from the so-called electrohydrostatic force. Quantitative treatment leads to a number of relationships between transport number, diffusion constant, specific conductivity, and the partial molar volumes and charges of the components, and suggests the possibility of determining the charge carried by metals in molten mixtures, and a new method of determining diffusion constants. Good agreement is obtained between the results of the theoretical treatment and the sparse experimental data available. In cadmium and zinc amalgams the mercury is present almost entirely as single charged positive ions (and/or Hg_2''), whilst the cadmium and zinc are present as Cd'' and Zn'' respectively. [See also following Abstract.] H. F. G.

3791. Electrolytic Fraction of the Conductivity of Amalgams and Other Alloys. Part II. C. Wagner. *Zeits. f. phys. Chem.* **164.** *Abt.A.* **3–4.** *pp.* **231–240,** *April,* **1933.**—The author differs from Schwarz [see preceding Abstract] in regarding the movement of the individual ions and electrons as being practically independent of one another, but the equations obtained lead to results of the same order of magnitude. An approximate equation for the case of solid alloys is developed. [For Part I see Abstract **2652** (1932).] H. F. G.

3792. Anodic Behaviour of Cobalt. K. Georgi. *Zeits. f. Elektrochem.* **39.** *pp.* **209–219,** *April,* **1933.**—The initial air potential of cobalt in an acid electrolyte containing dissolved oxygen is between $-0 \cdot 1$ and $+0 \cdot 1$ volt, being greatest in solutions containing large anions. If the oxygen is replaced by nitrogen, the potential becomes more negative in all cases. The sulphate ion is exceptional in that it always yields the most negative values. Measurements similar to those made with nickel [see Abstract **375** (1933)] lead to the following conclusions : if it be assumed that only certain points on the surface are active, they must be larger than in the case of nickel, since the size of the anion is of little influence even in the case of the perchlorate ion; with phosphoric acid the ease of dissolution is somewhat restricted, but conditions are complicated by the insolubility of the cobalt phosphate formed, which may produce a passive film, although this appears improbable since, among other reasons, restricted ease of dissolution is observed also with trichloracetic acid. Increase of polarisation causes the appearance of an oxide or peroxide film on the electrode. The hydrogen ion concentration is also of importance for the establishment of the passive state; the process $Co+2H^{\cdot}\rightarrow Co^{\cdot\cdot}+2H$ at first proceeds as slowly as in the case of nickel, but when the hydrogen on the electrode becomes ionised it proceeds more rapidly on account of the greater active surface. H. F. G.

3793. Anode Reactions in the Lead Accumulator. E. H. Riesenfeld and H. Sass. *Zeits. f. Elektrochem.* 39. *pp.* 219–227, *April*, 1933.—The quantity of acid which disappears during discharge of the lead accumulator is less than is required by the classical theory, mainly as a result of the processes at the anode. Partly discharged anodes contain basic sulphate, and crystalline lead sulphate cannot be detected by X-ray analysis. It is concluded that during charge sulphate ions are discharged at the anode and higher lead oxides are formed by hydrolysis, as indicated in the following scheme: $(Pb(O, SO_4))_3+SO_4''\rightleftharpoons Pb_3(O,SO_4)_3SO_4+2e\rightleftharpoons Pb_3O_4+SO_4''\rightleftharpoons Pb_3O_4(SO_4)+2e\rightleftharpoons Pb_3O_5+SO_4''\rightleftharpoons Pb_3O_5SO_4+2e\rightleftharpoons 3PbO_2$. During discharge this process is reversed, the normal endpoint being basic lead sulphate; normal sulphate is formed only after long standing in the discharged state. H. F. G.

3794. Electrochemical Investigation of Brass. A. Ölander. *Zeits. f. phys. Chem.* 164. *Abt. A.* 6. *pp*, 428–438, *June*, 1933.—The potential of elements Zn/Li, Rb, Zn (Cl/Zn, Cu) and the temperature coefficients were measured for electrodes consisting of 46 different alloys at temperatures between 333° and 626° C. The results fully confirmed the equilibrium diagram of Bauer and Hansen, as far as the change of the γ-phase limit. The heat of transition of the β and δ-phases was calculated. The latent heat of fusion of zinc was found to be 28·4 cal./gm. F. J. B.

3795. Application of Compensated Valve-Voltmeter to Measurements of Glass Electrode Potentials. A. S. McFarlane. *Journ. Sci. Instruments*, 10. *pp.* 208–212, *July*, 1933.—Used in a null method of potential measurement, the valve-voltmeter described here has a maximum grid-input impedance of 5000 megohms, which is eminently suitable for recording glass electrode potentials. The voltage sensitivity is considerably greater than that of electrometer valve instruments as a class, and the instrument is more sensitive, and has a more stable zero than other instruments of a similar type using ordinary valves. Glass electrode potentials are measurable with it with an accuracy of 0·05 millivolt, which is roughly equivalent to 0·001 pH. AUTHOR.

3796. Durable Glass Electrode. D. A. MacInnes and D. Belcher. *Indust. and Engin. Chem.* (*Analytical Edition*), 5. *pp.* 199–200, *May* 15, 1933.—A glass electrode was designed with a robust glass spiral as the electrode. The spiral was made of a special glass (Corning 015.), and consisted of fourteen turns of about 2·5 c.m. diameter. The external diameter of the tubing was 5 mm. and the thickness of the wall about 0·6 mm. The spiral was sealed into a container and was connected with a calomel electrode and reservoirs. pH values were determined with the electrode for seven different materials; the results are in good agreement with the accepted values. F. J. B.

3797. Use of Bimetallic Anodes in the Electrolytic Synthesis of Alloys. C. Béchard. *Comptes Rendus,* 196. *pp.* 1480–1482, *May* 15, 1933.—The deposition of brass from a cyanide bath with a brass anode under conditions such that a copper-rich alloy is deposited causes a diminution of the copper content of the bath and an increase of the zinc content, although the surface of the anode assumes the appearance of zinc. When the superficial excess of zinc on the anode dissolves, the zinc content of the deposit increases and the anode loses its zinc-like appearance. These changes are repeated periodically. The frequency is constant under given conditions, but the amplitude, *i.e.*, the range of variation of the composition of the deposit, is greater when, instead of brass, a large zinc anode and small copper anode are used; under these conditions, when the demand for copper has been large, a deposit of zinc forms on the copper anode, and *vice versa.* When a simple potassium cyanide bath is used with zinc and copper anodes, the rates of dissolution of the metals are governed by the ratio of the exposed surfaces. H. F. G.

See also Abstracts 3282, 3707, 3768, 3770, 3775.

ELECTRONS AND PROTONS.

3798. Scattering Experiments with Fast Protons. R. v. Meibom and E. Rupp. *Ann. d. Physik,* 17. 2. *pp.* 221–232, *May,* 1933.—Diffraction rings are obtained by the scattering of protons of 180 kV energy in their passage through thin gold foils, and from the Debye-Scherrer formula an average wave-length is obtained which agrees with that calculated from de Broglie's theory to within ± 2·7 %. From the scattering pattern produced by 58-kV protons scattered at the edge of a gold foil, values of the wave-length are obtained in agreement with theory to within ± 2·5 %. When thin mica foils are used the scattering photographs show interference curves in contrast to the interference points obtained by scattering kathode rays under similar conditions. The potentials used ranged from 58 to 275 kV. F. C. C.

3799. Reflection of Kathode Rays at the Surface of a Single Crystal. S. Kikuchi and S. Nakagawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 430. *pp.* 80–91, *June,* 1933. *In German.*—Similar experiments to those of Kirchner and Raether [see Abstract 4551 (1932)] are carried out on the interference spots produced by glancing angle reflection of kathode rays of 100 kV energy at the surface of a ZnS crystal. The interpretation of the former authors is not accepted and apparent anomalies are considered to be adequately explained as due to imperfection of the crystal surface. F. C. C.

3800. Collision of Slow Electrons with Atoms. Part III. Excitation and Ionisation of Helium by Electrons of Moderate Velocity. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 140. *pp.* 613–636, *June* 1, 1933.—In this paper, inelastic collisions of electrons with helium—including ionising collisions—are investigated in considerable detail. A critical survey of the experimental material in the light of the calculations is given, and the range of Born's first approximation is fixed. All deviations from the formulæ derived from this approximation are explained, at least qualitatively, and it is found possible to develop a simple physical picture involving double collisions with the same atom which accounts for a number of observed collision phenomena. Among these are included the form of optical and X-ray excitation functions, and the diffraction of inelastically scattered electrons. [For Part II see Abstract 1631 (1933).] AUTHORS.

3801. Elastic Electron Scattering in Neon. A. L. Hughes and J. H. McMillen. *Phys. Rev.* 43. *pp.* 875–882, *June* 1, 1933.—The distribution in angle of electrons having energies ranging from 10 to 800 volts scattered by neon atoms was measured over a range from 7° to 150°. For the higher energies, above 600 volts, the scattering curves fall monotonically with increasing angle. For smaller energies, an increase of scattering with increasing angle in the large angle region becomes more and more accentuated as the energy is reduced to 35 volts. Below this the curves flatten out. The position of the minimum in the scattering curves shifts steadily to smaller angles as the electron energy is increased. The elastic cross section obtained by integration of the scattering coefficient multiplied by the sine of the scattering angle is computed for electron energies between 10 volts and 800 volts, and is compared with direct absorption measurements. Mott's formula is inadequate to describe the scattering curves even at the highest voltage, a result in accordance with a criterion set up by Morse. The low-voltage curves can be fitted satisfactorily to a formula of the type developed theoretically by Allis and Morse [see Abstract 4089 (1931)]. AUTHORS.

3802. Inelastic Electron Scattering by Helium Atoms. A. L. Hughes and J. H. McMillen. *Phys. Rev.* 44. *pp.* 20–24, *July* 1, 1933.—The angular distribution of electrons scattered by helium atoms when the electrons have lost 21·12 volts energy, thereby exciting the atom to the 2^1P state, has been studied for energies between 27·5 and 400 volts and over an angular range from 6° to 150° in most cases. For the higher energies the angular range over which measurements could be made was less, *e.g.*, for 400 volt-electrons measurements could not be made beyond 22°. The higher the original energy of the electrons, the less the number of electrons scattered with a 21·12 volt energy loss, and the steeper the angular distribution curve. For the lower energies (below about 100 volts) the curves fall gently to about 60° and then become practically flat up to 150°. One curve is given for the distribution of 42 volt-electrons which have lost 22·97 volts energy (excitation to the 3^1P state) and another for 400 volt-electrons which have lost 25 volts energy (thereby ionising the atom). Comparisons are made between the experimental results and theories proposed by Morse and by Massey and Mohr. A very direct comparison is possible with the theory of Massey and Mohr and a very satisfactory agreement is found. AUTHORS.

3803. Energy Distribution of Diffusing Slow Electrons. M. Didlaukis. *Zeits. f. Physik,* 82. 11–12. *pp.* 709–715, *May* 30, 1933.—It is deduced mathematically that the energy distribution caused in elastic collisions by the migration of electrons through a gas deviates considerably from accepted ideas of energy distribution. W. R. A.

3804. Diffraction of Electrons Through Large Angles. R. v. Meibom and E. Rupp. *Zeits. f. Physik,* 82. 11–12. *pp.* 690–696, *May* 30, 1933.—By reflection, at grazing incidence, of fast electrons from insulating crystals, dark bands are observed which may be followed up to angles of deflection of 160°. The bands are bordered on both sides by bright lines. One may regard the bands as curves of intersection of the zonal circles (*Zonenkreise*) of the crystal with the cylindrical surface of the photographic film. Their geometrical position is accordingly independent of the wave-length of the electrons. The breadth of the bands is proportional to the wave-length of the electrons and inversely proportional to the distance between the lattice-planes of the crystal. J. E. K.

3805. Fine Structure of Electron Diffraction Beams from a Gold Crystal and from a Silver Film on a Gold Crystal. H. E. Farnsworth. *Phys. Rev.* 43. *pp.* 900–906, *June* 1, 1933.—A study of the diffraction of low-speed electrons from a gold crystal has been made under the same conditions as those previously used [see Abstract **4545 (1932)**] for a silver crystal to determine the extent to which the previously observed fine structure characteristics depend on the nature of the atoms composing the crystal. For normal incidence there are many differences in the positions, structure, and relative intensities of the corresponding beams from the two crystals. Intensity measurements as a function of angle of incidence show some similarities in these characteristics for the two crystals, but there are many more differences. Results for a thin silver film on a gold crystal are in general the same as those for a massive silver crystal so that the different results for the two crystals appear to be real and not due to differences in surface irregularities. Differences are noted in the deviations from the surface grating formula during growth and decay of diffraction beams from the gold crystal and from the silver film on the gold crystal. This makes it appear unlikely that the number of atom lines in the elementary grating is the only determining factor. Beams which deviate from the surface grating formula may follow one of two depth grating formulæ. Some dependence of this characteristic on angle of incidence is noted. Since no beams characteristic of a surface gas lattice on the gold crystal were observed when gas was known to be present, the gas layer must be noncrystalline. AUTHOR.

See also Abstracts **3472, 3474, 3476, 3491, 3526, 3527, 3735.**

ELECTROSTATICS.

3806. New Statistics and Electrostatics. M. K. Gopalaiengar. *Indian Journ. Phys.* 7. *pp.* 531–537, *May* 20, 1933. *In English.*—Silberstein's application of the theory of metallic conductors to electrostatics is reconsidered from the standpoint of the new statistics, distinguishing therein two important cases. It is found that linear integral equations of the second kind are arrived at similar to the one obtained by him, but with altered constants, and in one of the cases discussed, an extra constant factor appears in the integral equation. The thickness of the electrified layer in charged conductors is obtained equal to $2 \cdot 08 \times 10^{-8}$ cm. and this is found to be independent of the temperature of the conductor. AUTHOR.

See also Abstracts **3729, 3752, 3753, 3754.**

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3807. Thermomagnetic Hysteresis in Steel. W. Y. Chang and W. Band. *Phys. Soc., Proc.* 45. *pp.* 602–608, *July* 1, 1933.—The temperature variation of a new hysteresis of the thermomagnetic e.m.f. in a steel wire is described. The hysteresis is of a negative or abnormal form, with a maximum amplitude of about 2 μV between up and down branches. The accuracy of the apparatus and method is critically examined, and an error of more than 0·5 μV in any reading is considered to be unlikely. A qualitative explanation of the phenomenon is given in terms of Gerlach's theory of spontaneous magnetisation, and Broili's results for nickel [see Abstract 4598 (1932)] are discussed from the point of view of that theory. AUTHORS.

See also Abstract 3760.

MAGNETISM AND ELECTROMAGNETISM.

3808. Magnetic Definitions from the Circuital Standpoint. A. E. Kennelly. *Am. Phil. Soc., Proc.* 72. 1. *pp.* 39–55, 1933.—An attempt to clear up discrepancies and variations of definitions in magnetic terminology. The early definitions of the permanent magnet era were replaced by those involving electromagnetic phenomena, and finally about 1870 the circuital phenomena of magnetic circuits placed a new aspect of the question before the magnetician, and it is the latter which are discussed in the present paper. Whilst none of the definitions offered is claimed as new, yet their collection into a consecutive series is a novelty. No modifications are offered for the classical definitions of susceptibility and intensity of magnetisation, but circuital definitions are suggested for the magnetic quantities ordinarily expressed by the symbols ϕ, F, R, ν_0, β, μ_0, B, H, L, μ, m, and μ/μ_0. The paper concludes with two Appendices giving numerical data for a non-ferric circuit computed both in C.G.S. magnetic units and in C.G.S. electrical units. Finally, a table is appended giving the equivalents between C.G.S. magnetic units and C.G.S. electrostatic units in the classical systems. S. G. B.

3809. Stereomagnetism. Parts I and II. O. v. Auwers and H. Kühlewein. *Ann. d. Physik,* 17. 1. *pp.* 107–120 *and* 17. 2 *pp.* 121–145, *May,* 1933.—In Part I the significance of atomic coupling and of crystalline superstructure in magnetic phenomena is discussed generally from the mathematical, physical and chemical points of view; in Part II the theory developed in Part I is applied to the interpretation of the magnetic properties of the perminvars. J. S. G. T.

3810. Magnetic Dipole Fields in Unstrained Cubic Crystals. L. W. McKeehan. *Phys. Rev.* 43. *pp.* 913–923, *June* 1, 1933.—Magnetic field components in certain cubic arrays of equal parallel dipoles are computed by two methods for points on the boundary of a dipole domain and for points near a vacated dipole position. The results may be of use in theories of ferromagnetism. Characteristic constants for a nonpolar cubic array of dipoles, previously computed by Bouman, are recomputed more precisely [see following Abstract]. AUTHOR.

3811. Magnetic Dipole Fields in Dislocated Cubic Crystals. L. W. McKeehan. *Phys. Rev.* 43. *pp.* 924–930, *June* 1, 1933.—A search is made for magnetic stability of orientation in cubic arrays of parallel dipoles subjected to dislocations of two sorts. In the first sort of dislocation cubic symmetry is lost but the dislocation is homogeneous. In the second sort, which simulates incipient or residual slip between two parts of one crystal, cubic symmetry is retained by each part separately, but the dislocation is sharply localised. Energy per dipole changes during dislocation in ways which do not account for observed directions of easy magnetisation in annealed crystals of iron and nickel. Changes of magnetic behaviour due to coldwork are of the proper order of magnitude to be accounted for in part at least by dislocations of the second sort. [See preceding and following Abstract.] AUTHOR.

3812. Magnetic Dipole Energy in Homogeneously Strained Cubic Crystals. L. W. McKeehan. *Phys. Rev.* 43. *pp.* 1022–1024, June 15, 1933.—The magnetic potential energy per dipole in homogeneously strained, originally perfect, cubic arrays of parallel equal dipoles is computed in two ways. Results for a few of these cases, previously treated by Becker and by Akulov in essentially these two ways, are corrected. A check formula, due to Powell, is given in general terms and used in proving the precision of the final results. [See preceding and following Abstracts.] AUTHOR.

3813. Magnetic Dipole Energy in Hexagonal Crystals. L. W. McKeehan. *Phys. Rev.* 43. *pp.* 1025–1029, *June* 15, 1933.—The magnetic fields at dipole positions in two hexagonal arrays of parallel dipoles are computed by two methods. One of these methods is also used to find the field in hexagonal close packing at a point on the hexagonal axis near a vacated dipole position. The hexagonal close-packed arrangement with axial ratio $c = 2 \times 6^{\frac{1}{2}}/3$ (as for spheres) is found to be magnetically stable by a small margin when magnetisation is along the hexagonal axis. The general expressions for the energy per dipole in homogeneously strained hexagonal arrays are solved and applied to two arrays, one simple hexagonal (H), the other close-packed hexagonal (HC), both with $c = 2 \times 6^{\frac{1}{2}}/3$. The results are applicable in cases where c differs slightly from this value. [See preceding and following Abstracts.] AUTHOR.

3814. Magnetic Quadripole Field and Energy in Cubic and Hexagonal Crystals. L. W. McKeehan. *Phys. Rev.* 44. *pp.* 38–42, *July* 1, 1933.—In crystalline arrays of equal and co-directed ideal bar magnets or circular Amperian current loops the magnetic field at certain important points and the magnetic potential energy of the array depend, if the linear dimensions of the magnetic elements are small in comparison with the shortest distance between elements, upon a series of terms, the first of which would be due to a similar array of dipoles. The second term, which, by analogy, has been styled the quadripole term, depends upon a sum, over all points of the array except the origin, of the fourth-order zonal harmonic of a certain angle, divided by the fifth power of the radius to the point. This sum is evaluated by a precise method for several cubic and hexagonal arrays, and the results are compared with such published values as are available. [See preceding Abstract.] AUTHOR.

3815. Magnetic Properties and Chemical Composition of Alloys. J. Dorfman. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 399–417, 1933. *In German.*—The empirical data derived from the work of Forrer, Sadron and Neel upon the saturation moments of nickel alloys is further developed upon the basis of new hypotheses. The results so obtained give (*a*) atomic moments which are multiples of the Bohr magneton and (*b*) atomic moments which have an absolute value which have a quite definite relationship to the electron valency number. It is shown that the conducting electrons play no rôle in the ferromagnetic properties: that the ferromagnetism of the " faulty " or anomalous electrons has its origin in the unclosed circuit of the atom and that in the case of alloys the foreign atoms with their surplus valency electrons can fill up these gaps in the atoms of the ferromagnetic materials and in this manner reduce the number of elementary magnets. The values for the number of nickel atoms dissolved in iron and cobalt are determined, and the data so obtained were proved for pure substances, whereby from the values of the susceptibility measurements and the saturation figures for magnetism, the ratio of the number of the ionised atoms to the number of neutral atoms was determined. The method is applied to several alloys and gives a new aspect regarding the nature of martensite and the ferromagnetism of Heusler alloys. S. G. B.

3816. Magnetic Properties of Electrolytic Iron. K. W. Grigorow. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 418–420, 1933. *In German.*—A series of authors have shown that iron or nickel when deposited electrolytically in very thin layers exhibits a very large hysteresis. The present work investigates this factor for iron deposited upon a copper tube. The current strength, the thickness of the kathode deposit, the material of the support upon which the iron is deposited and the effect of heat *in vacuo* upon the magnetic properties of the iron were determined. For relatively small current strength (1 ampere per dm.^{2}) the coercive force alters very little with the variation of current strength. Raising the current strength to about 2 amperes per dm.^{2}, or higher, the value of the coercive force rapidly increases. The thickness of the deposit was investigated for different values and it was found that for large current strengths the magnetic properties, *i.e.*, the coercive force and the remanence, were independent of the thickness of the deposit. In explanation of the rôle of the supporting material upon which the deposit rests a series of tests upon molybdenum and copper were made under exactly identical conditions. The same results were obtained in both cases except that whilst the iron adhered strongly to the copper the molybdenum held it only very weakly. The value of the hysteresis and specially the coercive force in the cases similar to those outlined above is, therefore, a property of the iron itself and is independent of either the thickness of the deposit or the nature of the supporting material. The influence of heat indicates that by merely heating from 100° to 150° C. there is no change, but by heating *in vacuo* between 400° and 500° C. an increase of coercive force occurs. At higher temperatures of about 700° C. a decrease in coercive force is noted. The value of the maximum induction and the remanence are little altered by heat treatment for deposits upon copper. Finally, over a period of several months the magnetic properties of the electrolytically-deposited iron remained unaltered. S. G. B.

3817. Curves and Calculations of Permeability and Hysteresis Loss in Thin Laminæ. W. Arkadiew. *E.N.T.* 10. *pp.* 220–222, *May,* 1933.—In a previous paper the author has described methods, both mathematical and experimental, for the measurement of the permeability and the losses in iron wires when subjected to very high frequencies. The present work extends these results to iron laminæ or thin iron sheets. The paper is entirely mathematical in character. S. G. B.

3818. Demagnetisation of Iron and Nickel by H.F. Alternating Fields. S. Procopiu and N. Florescu. *J. de Physique et le Radium,* 4. *pp.* 251–261, *May,* 1933.—Iron, steel and nickel wires of diameter

0·1−0·5 mm. were demagnetised by alternating magnetic fields of frequency $50-10^6\sim$ and maximum intensity 50 gauss. The demagnetising effect is less at higher frequencies and in small fields. On plotting the remaining magnetisation as a function of the intensity of the alternating field a curve consisting of three parts is obtained. At first, for small fields, the magnetisation remains approximately constant and then suddenly commences to decrease almost linearly with the field. For large fields the rate of decrease is much less and the curve approaches zero magnetisation assymptotically. Extrapolation of the second part to cut the axis at a point H_c leads to a definition of an " apparent coercive field." This is proportional to the square root of the frequency and to the diameter of the wire. A reasonable explanation of this is provided by the skin effect. A spontaneous remagnetisation of nickel under an alternating field is reported and attributed to a weak magnetic viscosity of nickel. J. E. R. C.

3819. Magnetic Permeability of Iron Wires in the Wave-Length Region of 46 to 1000 m. K. Kreielsheimer. *Ann. d. Physik,* 17. 3. *pp.* 293–332, *June,* 1933.—By the use of an audion as null indicator the Wheatstone bridge was successfully employed with very high frequencies with sufficient accuracy for the measurement of resistances and self-inductions. After the arrangement had been tested by means of non-magnetic material the high frequency resistance and the internal self-induction of iron wires were determined by direct measurement on the bridge and from these the magnetic permeabilities μ_R and μ_I could be calculated. The investigations were carried out in a frequency range of $\lambda=46-1000$ m. and in a range of field strengths of $H=0$ to about 12 oersteds. J. J. S.

3820. Propagation of Large Barkhausen Discontinuities. Part IV. Regions of Reversed Magnetisation. L. Tonks and K. J. Sixtus. *Phys. Rev.* 43. *pp.* 931–940, *June* 1, 1933.—The relations existing at a stationary boundary between saturated and antisaturated magnetic phases in a stretched NiFe wire have been investigated and a theory has been developed. Experimentally, both the minimum reversed (stopping) field required to stop the propagation of a moving discontinuity as well as the flux and magnetic pole distribution in the stopped boundary have been determined. Over the major portion of the boundary the pole field subtracted from the main field, and this demagnetising field was found just to neutralise the excess of the applied field over the critical field. This confirmed the view that reversal in the wire proceeds only while the total field exceeds the critical field. A simple pole strength distribution which complies with this view was found to be one in which pole strength varies linearly with distance. Its demagnetising field is approximately constant and checks the known excess fields reasonably well. Further refinement followed from recognising that at the forward end of the boundary the pole field adds to the main field and is neutralised there by the stopping field. As a result, it was possible, given the excess field, the length of stopping coil, and the total change in induction, to calculate roughly the length of the boundary and the magnitude of the minimum stopping field. Certain details of the pole and field distribution under the stopping coil have been considered, particularly the expected sharp increase in minimum stopping field as the main field approached the starting field for the wire. When first the main field and then the stopping field were removed, the boundary was found to remain in place without any major change. The theory accounts for the escape of such a stopped boundary when the magnetic fields were reapplied. Symmetrical regions of reversed magnetisation have been formed, both "spindles" and "rings," and some features of their behaviour have been explained. AUTHORS.

3821. Irregularities in Magnetisation. K. J. Sixtus. *Phys. Rev.* 44. *pp.* 46–51, *July* 1, 1933.—Line patterns of iron oxide deposited from a suspension, similar to those observed by F. Bitter on large crystals of iron and nickel, have been studied on cold-drawn, polycrystalline nickel-iron wires under uniform applied stress and in a magnetic field. The patterns consisted of parallel lines but they differed from the highly regular patterns published by Bitter, in that the spacing between adjacent lines varied considerably and in that they appeared very consistently in the same places even after changes in magnitude and direction of the applied field. The spacing of the lines lay within the range $0\cdot7$ to 10×10^{-3} cm. Both experiments on a wire under tension and the agreement of results on a twisted wire with conclusions from R. Becker's theory prove that the lines form perpendicular to the direction of induction in the material. No further evidence regarding the origin of the pattern could be found. AUTHOR.

3822. Magnetic Analysis of Internal Stresses. Part II. M. Kersten. *Zeits. f. Physik*, 82. 11–12. *pp.* 723–728, *May* 30, 1933.—The remanence loss caused by tension or compression was calculated by Becker's theory for ferromagnetics. The mean internal stresses can be determined, by the use of a simple relation, from the experimentally measured change in remanence. The method leads, in the case of plastically strained nickel wire, to nearly the same values of internal stress as were derived previously from the initial permeability and reversible work of magnetisation. [See Abstract 4592 (1932).] G. E. A.

3823. Polymorphic and Magnetic Transformations. H. Lange. *Zeits. f. techn. Physik*, 14. 6. *pp.* 226–229, 1933.—The modes of transformation which are observed in metallic systems are the polymorphic, hyperstructural and magnetic. Of these, the polymorphic is connected with a change in the crystal lattice which occurs at a definite temperature. The second mode is also connected with a lattice change in which a regular co-ordination of the atoms takes place. It is suggested that the different modes are connected with each other, and, taking the case of the hardening of steel, it is shown that the law of temperature in the austenite-martensite transformation is the same as that which holds for hyperstructural formation. G. E. A.

3824. Magnetic and Dilatometric Research on Hardening of Steel. W. Jellinghaus. *Zeits. f. techn. Physik*, 14. 6. *pp.* 229–230, 1933.—The transformation of austenite has been followed by using magnetic and dilatometric tests in which the steel was quenched from a high temperature and transformed at a constant low temperature. Using three temperature ranges, the time-law governing the transformation is found to be different in each case. G. E. A.

3825. Magne-Crystallic Action. Part II. Paramagnetics. K. S. Krishnan, N. C. Chakravorty and S. Banerjee. *Roy. Soc., Phil. Trans.* 232. *pp.* 99–115, *May* 23, 1933.—After discussion of earlier measurements on paramagnetic crystals, a description is given of the measurement of the principal susceptibilities of a number of paramagnetic sulphates and double sulphates, mostly monoclinic, by the methods used previously [see Abstract 2626 (1933)]. Magnetic anisotropy is weak in manganese ammonium sulphate, and in nickel salts, and the strong anisotropy of iron and cobalt salts is accompanied by a dependence of the mean suceptibility on the nature of the crystal. G. E. A.

3826. Magnetic Structure of an Iron Alum in Strong [Magnetic] Fields. J. Forrest. *Phil. Mag.* 15. *pp.* 1153–1162, *June,* 1933.—Measurements of the transverse magnetic component in thin discs of ammonium iron alum crystals in fields of strength up to 30,000 gauss are discussed. Evidence indicating the superposition of the effects of internal strain and foliation on a real variation of cubic crystalline structure is given. J. S. G. T.

3827. Principal Magnetic Susceptibilities of Some Paramagnetic Crystals at Low Temperatures. L. C. Jackson. *Roy. Soc., Proc.* 140. *pp.* 695–713, *June* 1, 1933.—An apparatus is described for the rapid determination of the principal susceptibilities of crystals at low temperatures, with an accuracy of about ½ to 1 %. Results are given for the following crystals: manganese ammonium sulphate, manganese sulphate (penta- and tetra-hydrate), ferric acetylacetonate, potassium ferrioxalate, cobalt sulphate and potassium ferricyanide. In agreement with recent theory the crystals containing ions with *s*-moment only present, or effective, are found to be magnetically isotropic to within about 1 %. Over the range of temperature employed, 290°–75° K., the $1/\chi T$ curves for the principal susceptibilities of cobalt sulphate are straight lines but these are not all parallel. Potassium ferricyanide shows a rather complicated behaviour. AUTHOR.

3828. Electric Polarisability and Diamagnetic Susceptibility of Molecules. S. Bhagavantam. *Indian Journ. Phys.* 7. *pp.* 617–621, *April* 20, 1933. *In English.*—A relation between the electric polarisability and the diamagnetic susceptibility of atoms, deduced by Vinti [see Abstract 5258 (1932)] has been tentatively applied to simple molecules. In place of the usual Langevin-Pauli formula for the diamagnetic susceptibility of atoms, use is made of the fuller expression given by van Vleck for molecules. The latter is characterised by the presence of a feeble paramagnetic term and the results show that its numerical value increases with increasing asymmetry of the molecule. The parallelism is to be expected theoretically. AUTHOR.

3829. Magnetic Susceptibilities of Hydrochloric Acid and Lithium Chloride Solutions. A. F. Scott and C. M. Blair, Jr. *J. Phys. Chem.* 37. *pp.* 475–482, *April,* 1933.—The specific susceptibilities of hydrochloric acid solutions (6–27 %) are a linear function of the concentration, *i.e.*, the susceptibilities of the solvent and solute are additive; the calculated molecular susceptibility of hydrochloric acid is $-22 \cdot 0 \times 10^{-6}$. In the case of lithium chloride the susceptibility varies in a linear manner with the concentration between the limits 0–19 % and 28–44·5 % (the saturation point); in the concentration interval 19–28 %, in which the composition varies from that of the decahydrate to that of the hexahydrate, the curve is abnormal. In the more dilute solutions the molecular susceptibility of the salt is $-27 \cdot 0 \times 10^{-6}$, and in concentrated solutions $-25 \cdot 4 \times 10^{-6}$. The difference is probably partly, though not entirely due to a change of the degree of hydration of the salt. Other physical properties of lithium chloride solutions have been reported as showing abnormal variations in the interval 19–28 %. H. F. G.

3830. Susceptibility of Paramagnetic Solutions. C. J. Gorter. *Phys. Zeits.* 34. *pp.* 462–464, *June* 1, 1933.—A reply to criticism by Fahlenbrach and Dogt [see Abstract 2609 (1933)] of a paper [see Abstract 5267 (1932)] by the author. W. R. A.

3831. Diamagnetism of Water at Different Temperatures. B. Cabrera and H. Fahlenbrach. *Zeits. f. Physik*, 82. 11–12. *pp.* 759–764, *May* 30, 1933.—In contrast to the results of Wills and Boeker it is shown that the susceptibility of water, is not influenced by different methods of treatment of the temperature range and conditions, or at least the influence, if any, is within the limits of experimental accuracy. The temperature coefficient of the susceptibility of water is given as $\alpha = +1 \cdot 15 \times 10^{-4}$ and appears to be constant for all temperatures between 0° and 100° C. The results of Wills and Boeker are compared with Fahlenbrach's determinations of the concentration relationships of aqueous $Ni\text{-}Cl_2$ solutions. S. G. B.

3832. Magnetic Moment of Samarium Oxide at Low Temperatures. E. C. Wiersma and B. H. Schultz. *Physica*, 13*e*. 5. *pp.* 171–174, 1933. *In English.*—The magnetic moment of samarium oxide has been determined at low temperatures. The lowest temperature was 14·18° K. Though the substance was probably very pure and the measurements accurate, the results were not in agreement with the calculations of (Miss) Frank for the free Sm ion [see Abstract 2120 (1932)]. AUTHORS.

3833. Magnetic Moment of a Hydrogen Molecule. G. C. Wick. *N. Cimento*, 10. *pp.* 118–127, *March*, 1933.—In measuring the magnetic moment of a hydrogen molecule, Frisch and Stern (not yet published) have succeeded in measuring separately the rotational moment, using rays of pure para-hydrogen, but their result was not in accord with the calculated value. The author's investigation on the magnetic moment of the perturbations due to the rotation shows that the latter induces currents in the electron cloud which necessitate a correction term in the magnetic moment of the molecule ; this effect is small, but by no means negligible with respect to the nuclear magnetic moments. An approximate formula is deduced for the magnetic moment and this appears to be in agreement with the experimental results. The view that the rotational moment is proportional to the rotation quantum is confirmed. T. H. P.

3834. Magnetic Moment of the Nitrogen Nucleus. R. F. Bacher. *Phys. Rev.* 43. *pp.* 1001–1002, *June* 15, 1933.—Three lines of the group $2s\,2p^4\,{}^4P - 2s^2\,2p^2\,4p\,{}^4D$ of NI have been examined for hyperfine structure. They were found to be single when examined with a Fabry-Perot interferometer, using a variety of plate separations. The line widths of two of the lines were measured. The absence of hyperfine structure is attributed to the small magnetic moment (μ) of the nitrogen nucleus. It is shown that, by using the results of Goudsmit, the measured line widths lead to an unusually low magnetic moment for the nitrogen nucleus, $\mu \geqq 0 \cdot 2\, eh/4\pi Mc$. Under certain assumptions about the structure of the nitrogen nucleus, this low value of the magnetic moment leads to the conclusion that the neutron has a magnetic moment in the opposite direction from its mechanical moment and about one proton magneton in magnitude. AUTHOR.

3835. Magnetic Susceptibilities of Common Gases. G. G. Havens. *Phys. Rev.* 43. *pp.* 992–1000, *June* 15, 1933.—The Faraday test body method, which had been developed and used by the author for finding the magnetic susceptibility of NO_2, has been applied to the measurement of the magnetic susceptibilities of several common gases at room- and at liquid-air temperatures. The following values × 10^6 were obtained for the molecular susceptibilities : $\chi(H_2) = -4 \cdot 0051$, $\chi(He) = -1 \cdot 096$, $\chi(Ne) = -7 \cdot 651$, $\chi(A) = -19 \cdot 23$, $\chi(CO_2) = -20 \cdot 88$, $\chi(N_2) = -11 \cdot 938$ at room-temperatures, and $\chi(H_2) = -3 \cdot 98$, $\chi(He) = -1 \cdot 91$, $\chi(Ne) = -7 \cdot 64$, $\chi(A) = -19 \cdot 8$, $\chi(O_2) = 11830$ at liquid air temperatures. These values are based on the provisional value of $\chi(O_2) = 3335 \times 10^{-6}$ at 20° C. The results show that the diamagnetic susceptibilities do not vary, within the experimental error, in going from room- to liquid-air temperatures. This is contrary to the 40 % change observed for hydrogen by Bitter. The susceptibility of oxygen was found to follow Curie's law to within 2 %. AUTHOR.

3836. Variation of the Magnetic Properties of Barium with Temperature. C. T. Lane. *Phys. Rev.* 44. *pp.* 43–45, *July* 1, 1933.—A discontinuity in the resistivity-temperature curve for pure barium at about 370°C. has led to the suggestion that two modifications of the crystal structure (α- and β-barium) exist, below and above this temperature respectively. Further, the similarity of the curve to that for the ferromagnetics makes it reasonable to suppose that a discontinuity in the susceptibility-temperature curve (*i.e.*, a Curie point) may exist. The susceptibility has been measured over a range of 400° C. and such a discontinuity is found to exist at about 350° C. The experimental results are completely at variance with the current theory for paramagnetics. AUTHOR.

3837. Integration of the Equations of Maxwell-Hertz for Uniaxial Crystalline Media. A. Tonolo. *Accad. Lincei, Atti,* 17. *pp.* 532–537, *April* 2, 1933.—The equations of the electromagnetic field are considered in the case of a uniaxial crystalline dielectric with a view to obtaining solutions that will satisfy certain boundary conditions. A fundamental solution of the equations is obtained which helps towards finding the general solution. A. J. McC.

3838. Faraday's Law as a Basis of Electromagnetic Theory. H. B. Phillips. *J. Math. Phys.*, 12. *pp.* 259–273, *May,* 1933.—An electromagnetic field is characterised by electric intensity E and magnetic induction B. According to Faraday's law of electromagnetic induction the line integral of E around any closed curve is proportional to the rate of diminution of magnetic flux through a surface having that curve as boundary. This and other principles are usually combined in the development of electromagnetic theory. The object of this paper is to show that with any two vectors satisfying Faraday's law are associated quantities having the properties of charges, currents, and potentials. Any such pair of vectors thus determine a possible electromagnetic field. J. J. S.

3839. Unipolar Induction. L. Slepian. *Phys. Zeits. d. Sowjetunion,* 3. 5. *pp.* 469–486, 1933. *In German.*—Experiments are described in which an occurrence of surface charges on rotating symmetrical and unsymmetrical magnets was established. As explanation of this phenomenon it does not seem possible to assume Faraday's hypothesis of the immobility of the magnetic field of a rotating symmetrical magnet. It is maintained that in all motions of the sources of the magnetic field (magnetised masses and electric currents) the magnetic field has only a translatory motion with the elementary centres, without taking part in their turning motion. The magnetic field moves not as a unitary system but as a totality of independent parts, of which each separate part is connected with its elementary source (magneton, electron, ion), moving with them translationally, but not rotating. This conception gives a solution for the so-called problem of unipolar induction in its widest sense, and likewise an explanation of the results described in the paper. J. J. S.

3840. New Formulæ for the Calculation of Self and Mutual Induction of Coaxial Circular Coils in Terms of Arithmetico-Geometrical Scales. L. V. King. *Phil. Mag.* 15, *pp.* 1097–1114, *June*, 1933.—From Ampère's expression for the contribution of a current element to the magnetostatic field of an entire circuit, it is possible to obtain a new and useful expression for the mutual inductance in the following cases: (*i*) Maxwell's two formulæ for co-axial circles; (*ii*) circle and co-axial helix; (*iii*) cylindrical current sheet and co-axial helix; (*iv*) self-inductance of cylindrical current sheet. The use of the arithmetico-geometrical scales used by the author [see Abstract 998 (1922)] to obtain highly convergent expressions for the mutual inductance of co-axial circles, has now been extended, by the use of trigonometrical recurrence formulæ, to include useful computational forms for the direct calculation of M, without reference to tables of elliptic integrals, for the above-mentioned circuits forming part of absolute electrical standards equipment. Such calculations are now required to an accuracy represented by arithmetical computations to at least seven significant figures. AUTHOR.

3841. Use of Arithmetico-Geometric Mean Series for the Calculation of Elliptic Integrals, with Special Reference to the Calculation of Induction. F. W. Grover. *Phil. Mag.* 15. *pp.* 1115–1133, *June*, 1933.—The absolute formulæ for the calculation of the self and mutual inductance of circular coils involve elliptic integrals. Tables are available of the complete elliptic integrals of the first and second kinds. For the third kind usually a relation is employed involving complete integrals of the first and second kind and also incomplete integrals. For the incomplete elliptic integrals of the first and second kind Legendre's tables are mostly employed. For present-day accuracy of absolute electrical measurements interpolations in these tables are necessary and this is a tedious and lengthy process. King gave formulæ for the calculation of all three kinds of elliptic integrals and for the accurate calculation of inductance. In the present paper the use of these formulæ for numerical calculation is illustrated using 7-figure logarithms for all except unusual cases and for the latter 8-figure logarithms or a calculating machine with a table of natural trigonometric functions such as those of Roussilhe and Brandicourt suffice. The results obtained by the arithmetico-geometric mean series formulæ agree with those obtained from using Legendre's tables and effect a considerable saving of time. R. S. R.

3842. Magnetostriction. A. Schulze. *Zeits. f. Physik*, 82. 9–10. *pp.* 674–683, *May* 23, 1933. *From the Reichsanstalt.*—The validity of the linear relation between magnetostriction and the square of the intensity of magnetisation is pointed out and discussed in the case of single crystals of iron, of single-crystal and polycrystalline nickel, and also of some ferromagnetic alloys. [See also Abstract 1742 (1932).] J. J. S.

3843. Principles of Construction of Magnetic Compasses. M. Tenani. *Accad. Lincei, Atti,* 17. *pp.* 641–644, *April* 23, 1933.—A discussion is given of the methods of avoiding the perturbing effect of vibrations on magnetic compasses. The author has constructed some models which functioned well even under exceptionally difficult conditions in some modern ships. A short account is given of a small model suitable for use in aeroplanes which has been successful in undergoing tests of its action.
J. J. S.

3844. Theory of Moving-Coil Oscillograph. Rousseau. *Assoc. Ing. Él. Liége, Bull.* 11. *pp.* 91–102, *April,* 1933.—A development of the theory of moving-coil oscillographs (excluding the bifilar type). The paper is divided into two parts, dealing first with sinusoidal currents and subsequently with non-periodic phenomena. Attention is drawn to certain features not usually mentioned in the ordinary theory of moving-coil oscillographs.
A. B. W.

3845. Demonstration of Eddy Currents in Conductors of Various Shapes. D. Brown. *Phys. Soc., Proc.* 45. *pp.* 556–558, *July* 1, 1933.—A method is described whereby it is possible to demonstrate visually the existence of eddy or Foucault currents in masses of conducting material, and the way in which the flow of the currents may be distorted or baffled by suitable slots or laminations. The experiment is very easy to set up.
AUTHOR.

3846. Modified Torsion Balance for Magnetic Measurements. J. Dorfman and I. Kikoin. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 421–428, 1933. *In German.*—Modifications in the method of mounting the torsion arm and the specimen tube in a magnetic balance are described. Experimental data on H_2O, NaCl, and KCl are used to test the apparatus. Data on several Pt and Pd complex salts are also given.
W. R. A.

3847. New Method of Estimating Magnetic Atomic Moments. J. Dorfman. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 439–441, 1933. *In German.*—A method based on the scattering of monochromatic atomic rays is discussed.
W. R. A.

See also Abstracts 3483, 3489, 3670, 3807.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3848. Heating Effects in Porous Bodies due to Short Waves. H. Bordier. *J. de Radiologie et d'Électrologie,* 17. *pp.* 283–288, *May,* 1933.—Considerable heating effects are observed when bodies are placed in the field of electromagnetic waves of the order of 10 metres wave-length. This heating is a maximum when $\nu = 2C/K$, where ν is the frequency, C the conductivity of the body and K the dielectric constant. Experiments are described in which porous pots are subjected to the field of 10-metre waves and the rise in temperature is observed. In the dry state a rise in temperature of 15° C. is obtained, but when the body is saturated with water the rise may be as much as 67°, reaching a maximum in each case. Other liquids examined (ethyl ether, acetone, chloroform, methyl alcohol) show intermediate effects.
J. E. R.

3849. Skin Erythema Dose in Terms of Roentgens, in Superficial Therapy. G. C. Andrews and C. B. Braestrup. *Am. J. of Roentgenology and Radium Therapy,* 29. *pp.* 663–666, *May,* 1933.—Meyer, Glasser and Braestrup, prior to the adoption of the international R unit of quantity of radiation, determined the relationship of the erythema skin dose, in relation to the German R unit. The present paper determines this relationship in respect to the recent international R unit. The experiments were carried out on 24 patients whilst being treated for acne. Details of fields of exposure, etc., are given. The authors conclude that the skin of various patients responds to equal doses of X-rays as measured physically, with surprising uniformity, given equal radiation quality and experimental conditions. With medium sized fields of irradiation the erythema dose is 400 R for the two qualities of X-rays usually employed in dermatology, but the skin reaction is slightly less intense for short-wave radiation and the influence of the wave-length of the radiation, increases as the field of irradiation is increased. B. J. L.

3850. Effect of X-Rays and γ-Rays Upon the Eggs of Drosophila Melanogaster. O. Glasser and F. R. Mautz. *Am. J. of Roentgenology and Radium Therapy*, 29. *pp* 815–825, *June*, 1933.—It has been found that the eggs of *Drosophilia melanogaster* offer a convenient method of quantative biological measurements of radiation intensity, particularly since the quantities of radiation necessary are small. The present authors give, in great detail, the method of production of eggs for this purpose, particularly in relation to temperature of incubation, humidity and the effects of parasites and light. Factors influencing the radiosensitivity of the eggs are discussed and the technique of control of the eggs. Eggs produced under these conditions were irradiated with measured doses of X-rays and radium γ-rays and the authors conclude that the eggs are not suitable for absolute determination of radiation dosage. Comparison made with the eggs suggests that 300 R units of X-rays are equivalent to 450 R units of radium γ-rays. Biological differences in this respect are related to the analogous differences in respect to skin erythema. The technique of physical dosage measurement is detailed. B. J. L.

3851. Recent Progress and Present Status of Radiology. A. C. Christie. *Radiology*, 20. *pp*. 405–410. *May*, 1933.—A Presidential Address to the American College of Radiology, reviewing progress in the application of X-rays and radium rays, for diagnostic and therapeutic purposes, particularly from the U.S.A. aspect. The author lays stress upon the fact that the mere possession of X-ray apparatus is insufficient, *i.e.*, that the application of X-rays to diagnostic and therapeutical purposes is a true speciality dependent upon special knowledge and experience. B. J. L.

3852. Change in Definition Occurring with the Bucky Diaphragm of the Mobile Type. W. W. Fray and W. T. Hill. *Radiology*, 20. *pp*. 456–463, *June*, 1933.—In the application of the Potter Bucky grid to an examination couch, in order to permit the grid to be moved to or from any particular region of the patient at will, the beneficial effect of increased definition may be lost, owing to the increased distance between the patient and grid. An apparatus is described in which this distance is reduced and the results of tests in relation to improved definition, as measured by a test object, are detailed. B. J. L.

See also Abstracts 3422, 3641, 3642, 3656.

OSCILLATIONS.

3853. Barkhausen-Kurz Oscillations. H. Alfvén. *Zeits. f. Physik*, 83. 3–4. *pp*. 222–233, *June* 14, 1933.—In order to study the oscillation mechanism in Barkhausen-Kurz (or Gill-Morrell) oscillations a method is worked out for measuring the (positive or negative) resistance of the valve in the non-oscillating condition. The resistance depends on the working tension. The minima of the resistance curves represent the vibration range of the valve. These have nothing to do with resonance oscillations. Under simplified assumptions a theory of the B-K oscillation is given. The electron motion disturbed by an a.c. tension produces in the electrodes, through induction, currents which have another phase than the tension. Whether they give positive or negative resistance, induction or capacity, depends on the working conditions. The theoretical resistance curves agree with the experimental. J. J. S.

3854. Effect of Circuit Parameters on the Constancy of the Frequency of a Pliodynatron. W. C. Sears. *Physics*, 4. *pp*. 241–245, July, 1933.—A study is made to determine the way in which the frequency of the pliodynatron oscillator depends upon the plate and control-grid voltages. The optimum operating voltages for greatest constancy of frequency are discussed. A new theoretical expression for the frequency of this oscillator is derived. The theoretical frequency variation with plate voltage is shown to be closely in agreement with the experimental variation. AUTHOR.

3855. Electron Oscillations in High Vacua. J. Müller. *Hochfrequenztechn. u. Elektroakustik*, 41. *pp*. 156–167, *May*, 1933.—The equations are given for a plane streaming of electrons between two infinite plane electrodes, when the external total current density, the field ratios at the electron source and the electron emission velocity are given, under the assumption that at each point of the space electrons are found with only one velocity. The relations are employed in a discussion of the space-charge effects and are applied to two particular cases. In the first case the electrons enter the space with current density and with velocity constant with respect to time. In the second case the initial electron current density may have any value whatever and the initial velocity may be zero. In both cases the conditions for external current and potential ratios constant with time are derived and then the effect of superposing small current variations on the constant current is considered. In both cases the arrangement behaves towards a.c. as a series or parallel combination of a capacity and a resistance. The dependence of this capacity and resistance on the frequency is found for both cases. Within certain frequency limits the arrangement may behave as a negative resistance, so that h.f. oscillations may be generated. A. W.

3856. Analogy between Electrical and Mechanical Oscillations. C. Ramsauer. *Phys. Zeits*. 34. *pp*. 459–461, *June* 1, 1933.—The incompleteness of the usual mechanical analogies to the electrical oscillations of two capacities connected by an inductive resistance is discussed. The oscillations of a mass of gas between two hollow spheres connected by a narrow tube containing a turbine of appreciable inertia provides a complete and instructive mechanical analogy. J. E. R. C.

See also **Abstracts 3758, 3848.**

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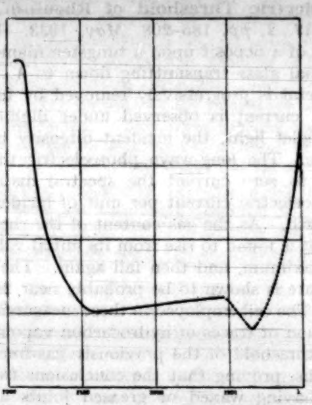
PHOTOELECTRICITY.

3857. Photoelectric Threshold of Rhenium. A. Engelmann. *Ann. d. Physik,* 17. 2. *pp.* 185–208, *May,* 1933.—Rhenium is investigated in the form of a deposit upon a tungsten filament in an evacuated cell made of special glass transmitting down to $\lambda = 248\ \mu\mu$. The gas content of the metal is progressively removed by intermittent glowing. The photoelectric current is observed under illumination with monochromatic ultra-violet light, the incident intensity being also measured with a thermopile. The long-wave photoelectric threshold is obtained by extrapolating to zero current the spectral distribution curve, *i.e.*, the curve of photoelectric current per unit of incident intensity against incident wave-length. As the gas content of the rhenium is diminished, the long-wave limit is found to rise from its initial value of about 267 $\mu\mu$, pass through a maximum, and then fall again. The value for the completely gas-free state is shown to be probably near 248 $\mu\mu$ and certainly below 253·7 $\mu\mu$. The cell employed in these measurements has no ground joints. Introduction of traces of hydrocarbon vapours is found to cause the photoelectric threshold of the previously gas-free rhenium to rise to higher wave-lengths, proving that the conclusions from results obtained with other cells having waxed or greased joints are erroneous. The results are discussed in the light of Fowler's theory of the temperature dependence of the spectral distribution curve. L. A. W.

3858. Photoelectric Effect of Cuprite Crystals. Anna Joffé and A. Joffé. *Zeits. f. Physik,* 82. 11–12. *pp.* 754–758, *May* 30, 1933.—The photo-electromotive force and the inner photoelectric effect of cuprite crystals are investigated, and it is found that the explanations hitherto advanced are unsatisfactory. The potential distribution in an illuminated crystal does not agree with the diffusion theory, nor does the dependence of the photo-electromotive force on the intensity of the light. By illuminating one side of the crystal through one electrode a considerable asymmetry of the current is established. If the field-strength exceeds 1000 volts per cm., illumination with white or red light produces a 30 % decrease of current. These phenomena appear only by co-operation of the photocurrent and the dark current. J. E. K.

3859. Use of Photoelectric Cells Coated with Fluorescent Substances, as Measuring Instruments in the Ultra-Violet. Study of the Sensitivity Curve. P. Dubouloz. *Rev. d'Optique,* 12. *pp.* 114–123, *March,* 1933.—By coating the outer glass wall of a photoelectric cell whose maximum sensitivity lies normally in the visible spectrum, with a layer of a fluorescent substance which emits visible radiation when excited by ultra-violet light, a photoelectric cell is obtained whose maximum sensitivity lies in the ultra-violet. Admitting that the fluorescent light has the same character whatever the wave-length of the primary radiation, it is clear that the form of the sensitivity curve of the fluorescent photoelectric cell, is determined solely by the yield of fluorescent light as a function of the primary wave-length, *i.e.*, by a property of the fluorescent substance only. Another advantage of such composite cells is that a sensitivity curve can be obtained which is practically constant over an extended wave-length range in the ultra-violet. Using a potassium cell and sodium salicylate as the fluorescent substance, the author determined the sensitivity curve in the range $\lambda = 0{\cdot}20$ to $\lambda = 0{\cdot}40\ \mu$ (*see Figure*). In the regions where the curve is dotted, lines



and bands in the spectrum of the arc used as light source prevented measurements being made. The ascending portion of the curve, for $\lambda > 0{\cdot}37\ \mu$ corresponds to the low wave-length extremity of the normal sensitivity curve of the cell. The nearly flat portion extends from $0{\cdot}35\ \mu$ to $0{\cdot}25\ \mu$ and then follows a rapid increase which is surprising but appears to be genuine. W. S. S.

3860. Photoelectric Properties of Magnesium. G. Déjardin and (Miss) R. Schwégler. *Comptes Rendus*, 196. *pp.* 1585–1587, *May* 22, 1933.—Magnesium photoelectric cells were prepared (1) by condensing magnesium vapour on the glass wall of the cell, (2) by kathodic sputtering, and (3) by the partial volatilisation of a Ba-Mg alloy (25–30 : 75–70). In (1) the threshold was at 3400–3500Å, and emission, σ (in (in 10^{-5} amperes per watt) for 3130Å was $0{\cdot}4-1{\cdot}0$, and for 2537Å $4{\cdot}0-7{\cdot}9$; in (2) and (3), provided that the temperature of volatilisation was $\ngtr 900°$, results were similar to those in (1), but if the temperature were higher (3) indicated presence of barium, the threshold being at 5000–5500Å, with change of slope at 3400, and σ for 3130 and 2537Å 14 and 25 respectively. [See also Abstract 4565 (1932).] C. A. S.

3861. Optical Absorption at Surface Layers with Double Photoelectric Spectral Selectivity. W. Kluge. *Phys. Zeits.* 34. *pp.* 465–472, *June* 15, 1933.—Measurements are made upon a special photoelectric cell with a plane regularly reflecting kathode surface of the type Ag-M_2O-M (M=K or Cs), the layer M_2O-M having an estimated thickness between 20 and 50$\mu\mu$. The magnitude of the photoelectric yield (in coulombs per incident cal.) and the percentage reflection from the kathode are measured simultaneously, using monochromatic illumination at the angle of incidence 55°. The results are given in the form of curves showing the variation of photoelectric yield and reflection with wave-length from 400 to 1000$\mu\mu$, not only for unpolarised light but also for the cases in which the electric vector is parallel to the plane of incidence ($E_{\parallel}$) and perpendicular

to the plane of incidence ($E_\perp$). The cells show double photoelectric spectral selectivity, *i.e.*, maxima of photoelectric yield at two wave-lengths. It is found that these maxima do not correspond to minima in the reflection curve. The fact that the long-wave maximum of photoelectric yield is more marked for $E_\parallel$ than for $E_\perp$ is taken as evidence that this maximum is associated with an optical absorption band of a surface layer of adsorbed alkali metal atoms. It is suggested that the short-wave photoelectric maximum may be due to the optical properties of the carrier metal silver.
L. A. W.

3862. Photoelectric Valve. J. Kunz and J. T. Tykociner. *Physics*, 4. *pp.* 246–254, *July*, 1933.—The object of this experimental investigation was to determine the nature of the valve effect. After the description of the valve some characteristic and photometric curves are given. Sensitivity curves are then described which show the relation between the wave-length and the photoelectric current per unit of light energy. These curves show distinct maxima, like ordinary photoelectric cells; this character of the sensitivity curves support the theory that the effect is primarily a photoelectric phenomenon connected with space charges. Other assumptions are shown to be untenable. Some additional phenomena, especially of the dark current, and experiments with various modifications of the valve are reported. AUTHORS.

See also Abstract 3685.

PIEZOELECTRICITY.

3863. Motion of a Quartz Crystal in an Electrostatic Field. A. de Gramont. *Comptes Rendus*, 196. *pp.* 1705–1707, *June* 6, 1933.—Two arrangements are described whereby quartz crystals may be set in rapid rotation by the application of alternating electrostatic fields. G. G. S.

See also Abstract 3316.

THERMIONICS.

3864. Disintegration of Thoriated Tungsten by Recoiling Positive Ions. A. Gehrts. *Zeits. f. techn. Physik*, 14. 4. *pp.* 145–152, 1933. From the *Reichspostzentralamt.*—The existing experimental data are reviewed, and it is considered that the thorium atoms are mobile over the tungsten surface and further, that the ions can convert their energy of neutralisation into kinetic energy which is conveyed by recoil to the kathode. This conclusion is in agreement with the results of Kingdon and Langmuir and of Hull, the onset of disintegration at a thoriated surface being approximately independent of the nature of the gas and dependent only on the energy which the ion conveys to the kathode. The suggestion of v. Hippel that the ion causes intense local heating on the surface of the kathode and that the disintegration process is purely one of evaporation is not applicable to the thoriated tungsten kathode. The disintegration process depends much more upon direct energy interchanges between the ions and the surface molecules. F. C. C.

3865. Adsorption of Thorium upon Tungsten. W. H. Brattain and J. A. Becker. *Phys. Rev.* 43. *pp.* 428–450, *March* 15, 1933.—A study has been made of the thermionic emission from thorium deposited upon tungsten, with special regard to its dependence upon temperature and the amount of thorium deposited upon the surface. It is found that at a given temperature, the emission increases with increase of the thorium up to a point and afterwards falls off and approaches its final value asymptotically. This final value is of the same order as that to be expected for pure thorium. The results are compared with those obtained for thoriated tungsten wire. The dependence of the emission upon the applied field varies with the amount of thorium upon the surface. The evaporation and migration of the thorium was also investigated. The evaporation rate depends upon the temperature and upon the fraction of the surface covered. It was possible to deposit thorium on one side of a tungsten strip and to observe its migration to the other side. The migration occurs at an appreciable rate at 1500° K and the migration coefficient depends upon the temperature and the amount of thorium. For a given set of conditions the heat of migration is given as 110,000 cal. per mol. J. E. R. C.

See also Abstracts 3688, 3760.

THERMOELECTRICITY.

3866. Thermoelectric Properties of Platinum-Rhodium Alloys. F. R. Caldwell. *Bureau of Standards, J. of Research,* 10. *pp.* 373–380, *March,* 1933.—The thermal electromotive forces and thermoelectric powers of a series of platinum-rhodium alloys against pure platinum have been determined from 0° to 1200° C. The results obtained are compared with those obtained by other investigators. The specimens used in this work contained the following percentages of rhodium, 0·100, 0·500, 1·000, 5·00, 21·6, 39·0, 51·6, 56·6, 61·2, 80·7, and 100·00. AUTHOR.

3867. Thermoelectric Powers. A. W. Foster. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 401–405, *April,* 1933.—The thermoelectric powers of nickel and nickel-chromes, with 1 % and 2 % of chromium, are accurately measured against copper, and the changes in the specific heat of electricity at the Curie point are found to be lowered very rapidly by the addition of small amounts of chromium. A. D.

3868. Thermotension between Half Conductor and Metal. G. Mönch. *Zeits. f. Physik,* 83. 3–4. *pp.* 247–252, *June* 14, 1933.—The thermotension for the case of a temperature dependence of the electronic concentration in the half conductor, as assumed with Cu_2O, is calculated according to the Fermi statistic. J. J. S.

3869. Thermoelectric Researches on Solid Electrolytes. H. Reinhold and A. Blachny. *Zeits. f. Elektrochem.* 39. *pp.* 290–305, *May,* 1933.—The temperature coefficient of isothermal solid circuits is equal to the difference of the thermo-forces of the thermo-circuits which can be formed from the phases at the contiguous junctions, and equal to the difference of the thermoelectric heterogeneous effect of these thermo-circuits. On the basis of this relation an experimental control of the e.m.f. of these circuits can proceed and also the thermodynamic treatment of solid isothermal circuits and solid thermo-circuits can be carried out uniformly from the standpoint of the μ-thermodynamics. The thermo-force of various thermo-circuits was measured. The thermodynamically calculated thermoelectric heterogeneous effect of the thermo-circuit contributes usually only a small fraction of the total thermo-force of the circuit. Determination of the magnitude and direction of the thermo-force of the thermo-circuit is therefore obtained almost exclusively from the magnitude and direction of the thermoelectric homogeneous effect. J. J. S.

See also Abstract 3760.